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CONTENTS:

	PAGE
Electricity in Dental Practice	29
The Current Controversy	30
Standard Cells	30
Half Truths	31
An Electric Apparatus for Indicating very slight Variations of Pressure in a Current of Gas (*illustrated*)	34
An Alternate Current Potentiometer	34
Changes of Voltaic Energy of Alloys during Fusion (*illustrated*)	34
Experiments on the Electric Discharge in Vacuum Tubes (*illus.*)	35
French Submarine Telegraphs and the Chamber	36
Electricity in Dental Practice	36
Obituary :—Wilhelm Weber (*illustrated*)	37
Electricity in the Art of Tanning (*illustrated*)	38
Concerning Lightning Rods	40
The Electric Light at Budapest	41
A Modified Form of Wheatstone's Bridge (*illustrated*)	43
Executions by Electricity	44
The Tramways Institute	45
London County Council	47
Notes	48
City Notes, &c :—	
India-rubber, Gutta Percha, and Telegraph Works Company	51
National Telephone Company	52
Chili Telephone Company	52
New Shanghai Electric Company	53
Traffic Receipts	53
Share List of Electrical Companies	54
The Progress of Electricity (*concluded*)	55
The Edison Electric Light Company *v.* the U. S. Electric Lighting Company (*continued*)	55
Brown's Rotary Expansive Engine (*illustrated*)	57
New Patents	60

ELECTRICITY IN DENTAL PRACTICE.

THE *Electrical Review* (our American contemporary) of the 27th ult., contains a short article on "Electricity in Dental Practice," by S. B. Palmer, M.D.S., in which the writer, after glancing in a few words at the "benefits which dentistry has received from the introduction of electrical appliances, holds out promises of far greater and more lasting benefits than the profession has been able to give, because even the rudimental teachings of electricity have not been required in dental education ; *with less than this the points which here follow cannot be discussed or appreciated.*" (The italics are ours.)

These glad tidings would be almost sufficient to take away our toothache, which proverbially leaves us at the dentist's door ; and all mankind (for who does not or has not suffered from his teeth) will rejoice at this "*annunciation.*" Electricity has come to the rescue, "*and has in store for coming patients*" (if they will only *come* to Mr. S. B. Palmer, M.D.S.), every advantage that a "*rudimental*" science can offer them.

"Electricity in Dental Practice" endeavours, however, to ascend beyond such rudimental teachings. The writer ventures on the higher grounds of "potential."

"We will consider," he says, "the effects of electric potentials between fillings and such electrolytes as come in contact with them in the mouth, be it softened tooth-structure, food, or fluids, *under the head of Electro-Dental Physiology* and Therapeutics, *better known in the profession as the Electro-Chemical Theory.*" Yet he has his misgivings about the possibility of raising his readers' minds to the scientific higher position from which he annunciates his theory, for "the writer well knows the difficulty of presenting the one word *potential* in a manner to be understood by those *who know not the rudiments of electrical science.*"

Now all this seems grandiloquent language, which appears in its proper light, when considered in connection with the rest of the article, the gist of which is : the respective merit of gold or amalgam for filling hollow teeth ; and the writer, to give himself an air of intellectual superiority to teach us rudimental science as applied to tooth-stopping, prostitutes the science, or, better, the name of electricity, without evincing the slightest degree of a true knowledge of electrical phenomena and their laws.

"The most prominent points" (of the electro-chemical theory ?) "consists in this : That the saliva of the mouth, the food, the condiments, &c., sustain the relations of a battery cell with its fluids. When any metallic substance is placed therein, it, as in ordinary cells, has its potential or polarity, be it a plate or a filling, whether the current is constant or intermittent, or whether it be injurious or not, &c." Now the merest tyro in electrical science will at once see that such special conditions, as are required to obtain an electric current through chemical action, do not exist here ; that the action of any acid or alkali in the saliva, or the food, on the gold, that *might* happen, is of a simple chemical nature, and it is questionable if the conditions for an electric current exist, even if the lining membrane of our mouth were as hard as that of the Russian sailor's, who enjoyed a glass of sulphuric acid which had been given him in mistake for strong brandy. However, we are, perhaps, too rash in our assertion ; we evidently have to learn the rudimental teachings of electricity to bring ourselves to the level of the author's ideas and his knowledge.

"*By cultivation and observation, currents are readily detected between gold and other metals when not in the same teeth*, so to speak ; the mouth furnishes a galvanometer almost as sensitive to taste as that of the '*frog's leg*' is to sight. When the tongue bridges over or closes the circuit from fillings of different potentials, work is done on the line." But if anyone should declare that he has not "*cultivated*" sufficiently to observe the current, the author answers : "Patients cannot describe the symptoms ; none but an electrician could *diagnose a case, nor can the subject be discussed by those having no experience.*" Verbum non amplius addam.

Looking at the subject from a physiological point, it would not be difficult to show how the author overlooks the chief factor in the production of decayed hollow teeth, which is at work before any metallic filling enters a tooth,

and continues to do so, whether gold or amalgam is employed by the "*older members of the profession*" or by Mr. S. B. Palmer, M.D.S., on his "*Electro-Dental-Physiology and Therapeutics*," better known by the profession as the "*Electro-Chemical Theory*"—*System*.

The author finishes his dissertation by declaring that he "claims no honours for the advanced position set forth. The object of appealing to the *Review* is to protect the dental profession against false positions in electrical science, &c." But, we may simply ask, who places the dental profession in a false position in electrical science—if not the author himself?

The indiscriminate use of such words as potential, electro-dental, electro-chemical theory, &c., reminds one of Goeth's saying :—

> "Denn eben wo Begriffe fehlen
> Da stellt ein Wort zur rechten Zeit sich ein.
> Mit Worten lässt sich kräftig streiten,
> Mit Worten ein System bereiten."

Electricity is making strides; beside the electropathic belt we shall now have electro-chemical-tooth-stopping.

THE CURRENT CONTROVERSY.

IN the pages of a contemporary, Prof. S. P. Thompson and Mr. J. T. Sprague have been "considering the electric current and how it flows, it toils not through the dielectric says the one, neither does it spin along the conductor says the other;" but with all respect to the authority of these gentlemen we do not think they have finally settled the question whether the electric energy flows through the dielectric or along the conductor. Prof. S. P. Thompson appears as the champion of the modern theory, due chiefly to Poynting and Heaviside, that the path of the electric energy from a source, such as a battery, to the work, such as a conductor emitting heat and other forms of energy, is along equi-potential surfaces in the dielectric medium. He endeavours to establish his position by general considerations quite distinct from the mathematical reasoning employed by Poynting, and fails, consequently, to give his adversary, Mr. J. T. Sprague, an adequate idea of what the new theory means.

Prof. Thompson reasons by analogy, a method of argument which usually gets the credit of being capable of proving anything. His line of argument is to show, first, that as in the case of alternating currents the electric energy must of necessity be transferred from a primary to a secondary circuit through the intervening dielectric; hence, by analogy, we are to infer, in the absence of experimental evidence to the contrary, that the energy flows from the battery to the conductor through the dielectric, rather than longitudinally along the conductor. He frankly admits that there is no experimental evidence that, during the steady flow of the current, the energy is transferred laterally across the medium, but claims that neither is there any evidence that, during the steady flow, the energy is transferred along the wire longitudinally. If this kind of argument is to have any validity, it will be necessary to show in the first place that there is a similarity between the alternating current and the steady current in all or most of the points which may be considered essential for the explanation of lateral flow in the alternating case. This, we think, Prof. Thompson fails to do. In the case of grosser fluids than the ether, such as air or water, there is not usually any similarity between the path of the energy due to alternating disturbances and that of energy due to a steady current, and we would not be justified in concluding that because *wave* energy passes diametrally across from one side of a maelstrom to the other, therefore the energy due to a *steady current* must do the same; we can see, in fact, that in the latter case it will pass circumferentially. In a cyclone, also, the energy of steady current passes circumferentially from one side to the opposite, but energy in the form of air waves would pass diametrally between the same two places. We agree with Mr. Sprague when he characterises this kind of argument as "bad logic and worse science." If it is on such logic as this that the much vaunted theory of the transmission of current energy through the dielectric is based, electricians may well hesitate to accept it, and Mr. Sprague deserves their thanks for drawing attention to its weak points.

Mr. Sprague, who undertakes the defence of the old view that the electric current is something flowing along the conductor, appears to us to be more successful as an iconoclast than as a defender of the faith. His theory of the nature of the current—or at least his statement of it—appears to have undergone considerable modification during his controversy with Prof. Thompson. He starts by saying that the most perfect analogue of the electric current is to be found in the hydraulic current, and compares an electric generator and circuit to a turbine with a completely closed circuit of water piping, but he seems in the end to have abandoned this view, and distinctly states that he does not consider that the electric current involves a "motion of translation," but is made up of some sort of "polar chains," which correspond to the stream lines of Dr. Lodge's diagram. This diagram of the stream lines of a current, flowing in a plate with a non-conducting obstruction in its centre, seems to have convinced even Mr. Sprague that the theory which supposes that the electric current is some material fluid possessing inertia, flowing along the conductor, is untenable. Of Mr. Sprague's "polar chain" theory, the explanation which he gives is too meagre for us to form any adequate opinion as to its value. The energy, according to this theory, appears to travel in waves along the conductor; but how and why waves of polarity should be transmitted along the particles of a conductor we have yet to learn.

The result of this interesting controversy appears to be that neither of the extreme views, old or new, are tenable; probably it may be discovered, when we know more about its mechanism, that the electric energy is transmitted partly by the dielectric, and partly by the conductor. In the study of electrolysis and the electric discharge, more especially the latter, there appears to be the greatest promise of a solution of this difficult problem.

STANDARD CELLS.

THE necessity for a good form of standard cell is daily becoming more apparent, and it is the one electrical standard which still appears to be in an unsatisfactory condition. It seems the most difficult of all the standards to fix with definiteness, though it is doubtful whether it is actually a difficult one to manufacture. There is undoubtedly a feeling abroad

that something yet requires to be done in the matter, in spite of constant assurances from various writers that they have had standard cells in use for several years, and they have found them to be still correct within a very small percentage of error. In all cases it is some form of the original Clark cell (tests of which we published in the very first number of the TELEGRAPHIC JOURNAL 19 years ago) that is referred to. Probably much if not all of the doubt indirectly expressed as to a satisfactory standard existing arises from improper use of the Clark cells, such as working them through a low resistance. In many cases, too, the sealed form of Clark cell has failed to be satisfactory from the same having partly dried up, owing to the glass containing vessel having cracked. This is not an infrequent fault, and it is one which up to the present has not been entirely overcome, though it seems somewhat surprising that there should be any difficulty in tracing the exact cause and remedying it. At the best, however, the Clark cell with its modifications are laboratory standards only, and can only be used as such. They are practically of no value to anyone not provided with comparatively expensive measuring apparatus. What is most wanted is some form of cell which can be connected direct to a voltmeter of, say, 1,000 ohms resistance, and which will indicate on the latter whether the voltmeter is correctly adjusted or not. In other words, we want a standard of really negligible resistance, and one which will not appreciably polarise. Hitherto the tendency has been to endeavour to make the cell of as small dimensions as possible, and although for laboratory working the consequent high internal resistance is of no consequence, it entirely precludes the cell being used for other purposes. It would appear as if it had never occurred to anyone to make a Clark cell of any other dimensions than that of one's finger, though there appears no reason, except the question of expense, why a cell, say, the size of a high crowned hat, should not be made. Such a cell, though not of course in any sense a portable one, could probably be used for the purpose suggested, viz., to verify directly a voltmeter of 1,000 ohms resistance. The great fault of the Clark form of cell is of course its tendency to polarise, a defect from which the Daniell battery is comparatively, though not entirely, free. In the case of Daniell standards the same tendency to small dimensions has always been shown, it never having occurred, apparently, to anyone to make a standard of very low resistance by making the cell of very large size.

Now that the Electrical Standards Committee of the Board of Trade have issued a memorandum of instructions with reference to the construction of standard cells, many will no doubt be manufactured and valuable observations made upon their reliability.

HALF TRUTHS.

SINCE the advent of central electric light stations in London, we have been able to get at a very fair estimate of the cost of producing the unit, and although this varies slightly in different districts, and under certain conditions of working, it can be ascertained to within a very small fraction of a penny. The comparative cost to the consumer of electricity and gas is, however, still shrouded in a sort of veil of mystery, and so it will continue so long as papers similar to that read at the recent meeting of the Incorporated Association of Municipal and County Engineers are circulated broadcast.

Its title, "The Progress of Electricity," was quite a misnomer, for the author resolved his discourse into a comparison of cost between gas and electric lighting in a manner which is decidedly misleading, so far as the gas interests are concerned. We will not discuss the theoretical deductions to which the author treated his audience, but deal simply with one of his hard facts.

The recent papers published in the REVIEW by Messrs. Ward Leonard, Grier and others, show that the majority of incandescent lamps now in use run at 3·6 to 4 watts per candle.

Now the comparison of electricity with Manchester gas at 2s. per 1,000 cubic feet, is at the price for which the public obtain their gas supply; therefore, to be just, we ought to speak of electricity at its selling price of 7d. or 8d. per unit, and not at 4d. per unit, the manufacturing price in the English Post Office; the high figure of 4,000 candle-power for 4s., quoted by the author, then becomes reduced to something between 1,500 and 2,000.

It is, we think, only fair to call attention to these points, for it is a matter in which the gas journals will assuredly take up the cudgels in defence of their interests; moreover, there is no good cause served by manufacturing half truths in any new industry. It is only the true understanding of the "hard facts" which will enable us to see in what direction economy in production or supply can be still further practised.

The time has gone by to compare a great public service, such as gas lighting, with what may be done in an ideal electrical installation, looked after by scientific men. We must treat the two systems upon their merits as competitors for public and private lighting, and this, we contend, has not been done in the article upon which we comment.

Naturally electricians or gas engineers are not likely to misinterpret the author's skilfully-worded championship of the electric light, but the general public will be—as was even the chairman who presided over the meeting—carried away by his redundant flow of eloquence. We have seen in years gone by the mischief which is created by misleading the great B.P., for when once it regains its powers of reasoning it is difficult enough to get its support again for legitimate enterprise. The future development of the electrical industry is then best fostered by showing would-be consumers of electrical energy exactly how matters stand, and gradually gain their adherence to the light of the future, as improvements enable suppliers to compete still more favourably with other illuminants.

It may, perhaps, be very gratifying for a great electrician to suddenly blossom out into a great sanitary engineer, but it is precisely because we think that the truth of the first appellation should not be endangered that we have taken unto ourselves the task of pointing out how the author's reputation may be jeopardised, especially amongst those who are opposed to his preaching or precepts, and who will probably regret that he ever substituted the electric light in his house and lived when he might so readily have ended his days eight years ago in a gassy atmosphere.

Electricity in the Alkali Industry.

THE annual report of Mr. Fletcher, the chief inspector under the Alkali, &c., Works Regulation Act, 1881, has been published, and, as usual, contains a vast amount of interesting information as to the state of the chemical industries of the United Kingdom. In his account of the various methods now proposed for extracting soda from its chloride (common salt), Mr. Fletcher observes that it would be incomplete if mention were not made of the proposals often entertained of decomposing salt by means of electrolysis. These have from time to time been reviewed, and now, again, attempts are being made to carry them into practice. The conditions of this problem have long been known, and it is obvious that the economic success of the electrolytic method depends on the facility for obtaining cheap electricity. Every improvement in the steam engine or other motor, or any advance in the structure of the dynamo, brings nearer the day when the splitting up of the salt may be accomplished as a simple act of electrolysis, but at present we cannot be said to have reached it.

Train Lighting Plant.

REFERRING to the description of the Holmes apparatus which appeared in our issue of May 15th, our attention has been drawn to the fact that the use of two dynamos arranged to give constant E.M.F. over a considerable range of speed has been described in the following patents :—

Mordey, No. 342, January 8th, 1889.
Sayers, No. 3,420, February 26th, 1889.
Holmes, No. 20,244, December 17th, 1889.

A Model City; or Reformed London.

UNDER this title a series of articles have been appearing in the *New Review*. No. IV. is devoted to Lighting by Electricity. The subject is, of course, only treated in a general manner, for the writer (Lord Rayleigh) merely describes the principles by which the electric light may be produced, and does not descend into details ; but the language in which the matter is expressed is admirably plain and succinct, and cannot fail to convey the precise intended meaning even to those readers who have not a particle of scientific knowledge. In the short account of the principle of the incandescent lamp, it is stated that the infusible nature of carbon attracted the attention of inventors at an early date ; and the now universal use of this material for the wire or *filament* allows the temperature, and consequently the economy, to be pushed much further than would be possible with any other substance yet tried. The fact that carbon is combustible, is not an objection to its use, as the incandescent wire, in any case, must be placed in a vacuum, because at a high temperature the filament is subject to a molecular bombardment which disintegrates it even when enclosed in a very attenuated atmosphere. To attain the high vacua necessary for glow lamps, a mercury pump must be used. From the remark, "it should never be forgotten that the triumphs of Swan and Edison are founded upon the previous scientific work of Sprengel and Crookes in the production of high vacua," we may clearly draw a conclusion as to the author's opinion on the broad principles under which the modern incandescent lamp became possible. Reference is made to the advantages and disadvantages of arc lighting and to the fact that the colour of the arc light is objected to, particularly by the fair sex; but, in reality, this blueness with which arcs are often credited is an illusion dependent upon contrast. How far lighting by glow lamps will supersede other modes of illumination must yet remain a matter of individual opinion. Many persons will prefer to use electricity instead of oil lamps on account of the cleanliness and convenience of glow lamps, notwithstanding their use may entail a largely enhanced cost. In some cases where electricity replaces candles, the comparison of the cost of the two methods of lighting will be more on an equality. It seems likely, also, that many dark underground places will be rendered available, and, to a certain extent, they have become so already. We can call to mind one or two places in this City of London in which, what Mr. G. P. R. James would have called, "the uttermost dungeon beneath the castle moat," has been converted into a light and convenient office or laboratory. We cannot but agree with Lord Rayleigh that there is much to be said in favour of arrangements similar to those now in force with certain gas companies, whereby a dividend beyond a certain standard carries with it an obligation to reduce in a proportionate degree the price charged to the public. There is then sufficient stimulus to induce the supplying company to introduce improvements without allowing the public to be crushed under the weight of an overbearing monopoly. We note, also, the author's statement anent the alternating current system, that the principal, and perhaps the only, advantage of this system is the facility with which it lends itself to transformation. For mechanical purposes the steady non-alternating current will be found to be better adapted. The present disadvantage of the electrical supply consists in the necessity of having a plant much larger than is required for the average consumption of current by the public for lighting purposes, in order to meet the great demand during a few hours of the day ; therefore, anything tending to equalise the consumption over a large part of the twenty-four hours would greatly simplify matters and would ultimately enable the companies to reduce their charges. The extensive application of electricity for distribution of mechanical power will aid towards realising this desirable end.

A Modern Admirable Crichton.

THE other day we received a letter which we imagine was intended for the light of publicity, and, as there may be "two or three eminent English specialists" willing to throw in their lot with the remarkable genius who has "succeeded in reducing all the processes of nature to the transposition of certain mechanical quantities in a homogeneous surrounding," we cannot refrain from putting them on the right path. Our only fear is that before negotiations have been finally concluded, the discoverer himself may have been placed in the homogeneous surrounding of a straight jacket and the labour of his life, therefore, lost to posterity.

"The enemy of art is the enemy of nature. Art is nothing but the highest sagacity and exertion of human nature."—LAVATER.

THE EDITOR.

Dear Sir,—I have no desire to be considered apart from my true character, viz., a painstaking mechanic who followed up physics and astronomy in his spare moments, yet I have succeeded in reducing all the processes of nature to the transposition of certain mechanical quantities in a homogeneous surrounding.

When I commenced the undertaking, I laid down the following rule for future guidance :—Find a measurable answer for all questions, even if you have to increase or decrease the actual size of the object, inasmuch as this proceeding will not essentially interfere with your calculations, for, when the geometrical proportions of the object are not altered, the same parts and properties are retained in all gradations of possible extension. In other words, I considered motion the reflex exhibition of the geometrical properties of the graining of matter, in connection with certain incidental details of a mechanical existence. In an automatous machinism, changes in the relative positions of its parts are the causes of the different effects, hence, when the construction of the machinism is definitely comprehended, its details are marvels of simplicity. I am no ways desirous to run foul of the existing theories, therefore I limit myself to stating that I can work out a simple mechanical interpretation of all the phenomena from the fall of the rolling stone down to the special synthesis that unites the elements. As a mechanic, and a mechanic only, I expect a substantial reward for a very substantial discovery. I am willing to let the arm-chair philosophers and the professors of science extract as much honour and glory out of it, in the future, as they think becoming to their pretensions.

For many reasons I prefer sharing my discovery with two or three eminent English specialists. I enclose stamped envelope, trusting

you shall have it in your power to advise a man who is not over worldly-wise.

I am, Sir,
Your obedient servant,
(Signed) G. BROWN.

"It may sound oddly, but it is true in many cases to say, that if men had learned less, their way to knowledge would be shorter and easier. It is, indeed, shorter and easier to proceed from ignorance to knowledge than from error. They who are in the last must unlearn before they can learn to any good purpose; and the first part of this double task is not in many respects the least difficult, for which reason it is seldom undertaken."—JERDAN.

The Electric Light and Fire Insurance Companies.

M. BUNEL, head architect of the Paris Prefecture of Police, and a member of the Technical Committee of the Prefecture of Police, charged with the installation of the electric light in the subventionised theatres, and M. Picou, a member of the same committee, have just presented to the chairman of the Union, one of the largest of the French fire insurance companies, a detailed report* as to the measures to take in the employment of electrical energy. The first question asked is: What are the dangers of fire resulting from the employment of electricity? In the first place, says the report, we must seek them in the installation of motor power—of boilers which are becoming more and more powerful, sometimes exceeding 1,000 H.P., with their thousands of kilogrammes of coal accumulated in the basements of large establishments, railways, theatres, shops, &c. Such an establishment consumes in a night ten tons of coal. Then comes the danger resulting from the use of sheet iron chimneys, which are cheaper than those of bricks and easier to instal in Paris; then the danger arising from the canalisations and the apparatus for the transport of energy. The peril is not in the incandescent lamp itself, nor even in the arc lamps, the wire of which can be protected, and which usually are placed high and well insulated; it is in the canalisations. There, in short, a badly made joint may become a furnace of heat, and the insulating materials are not entirely incombustible; fortunately, indiarubber when burning gives off a very characteristic odour. In houses the companies are helpless, depending on haphazard electricians, who are not very skilled and who work very cheaply with defective wires and apparatus insufficient in safety. The neighbourhood of electricity and gas is another danger, and this was clearly seen in the great explosion which took place at a restaurant at the corner of the Rue Royale and the Place de la Madeleine. The gas from a leakage may become ignited and detonate on contact with the spark from an apparatus; if a gas pipe melts, the gas which escapes may become inflamed. The danger resulting from the employment of accumulators in a badly ventilated and too restricted a position has also to be pointed out. The liquid in decomposition gives the elements of a gaseous explosive. Occasionally the accumulators are covered with a layer of thick oil, which is a bad practice. The object is to avoid the projection of acidulated water which forms the gaseous bubbles on whatever is in contact; but the oil becomes formed into an emulsion, and the froth which forms is a gas reservoir which inflames and detonates on the approach of a spark. The very high tension currents which are more and more employed, also become very dangerous when in the circuit cut-outs, and the interrupters, the ruptures of current are accompanied by the formation of a veritable voltaic arc. The Grosvenor Gallery station of London, which was converted into a simple transformation station on the creation of the immense Deptford works, was destroyed by a fire resulting from this fact. The authors of the report have analysed and discussed the French and foreign regulations relating to the establishment of electrical stations and conductors. On this point there is a French decree, dated May 15th, 1888, an ordinance of April 17th, 1888, concerning the use of the electric light in theatres, cafés, concerts, and other places of entertainment, and general instructions for the establishment of electric light apparatus, produced under the patronage of the professional syndicate of electrical industries. In France there are only two official documents on the matter. The assurance companies do not seem to find the decree and the ordinance sufficient to guarantee their interests; and they impose on their policy holders special rules inspired by the study of foreign regulations, and completed by taking into account the most recent improvements introduced in the employment of electric energy. They also endeavoured to figure out the variations of risks, from the fact of the existence of a distribution of electricity in a dwelling and the substitution of electricity for gas, or the co-existence of gas and electricity canalisations.

* Published at the Imprimerie Chaix, Paris.

Telepathy.

As in electricity we have an all-pervading force, of which we are not ordinarily conscious, but which on occasions produces some powerful and startling effects, so in the region of the mind, says Mr. Reginald Courtenay, may we not have effects rare and strange as are the slow moving fire-ball, or the lightning flash from an unclouded sky. Under peculiar and rarely occurring conditions, as yet but imperfectly known, certain mental influences predominate and mind perceptibly acts on mind. Telepathy, the name adopted by the Society for Psychical Research, is an impression or effect produced by one mind upon another, otherwise than through the recognised channels of sense, or through no known medium. This effect is said to be produced between living persons and departed spirits, or between two living people. In regard to communication with the departed spirits we have had no personal experience, for, although we have attended many a *séance* with the intention of holding communication with them, we suppose our presence has had a malign influence, or that the spirits have not been *en rapport* with us and so did not vouchsafe to us the least evidence of their presence. Among living mortals we have had a wider and more successful experience. Every day, almost, we feel convinced of the truth of telepathy. The sensation comes over us in this way: At a certain time each day an impression is conveyed to our mind, and to most of our friends' minds, and to the minds of most of their friends, that it would be a good and cheerful thing to be at charity with all men. Therefore to show outwardly, as well as inwardly, our good feeling towards one another, we smile and the rest of our friends reciprocate. This is the most striking instance we know of telepathy, with the single exception of Aslauga's knight.

The Gas Companies "Must Look to Their Bye-Products."

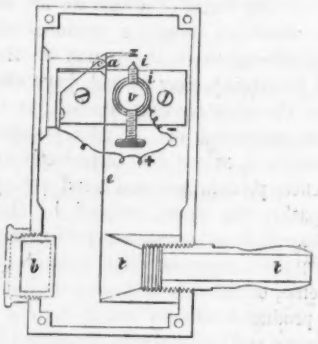
IN a recent lecture by Prof. E. J. Mills of the Laboratory of Technical Chemistry at Glasgow, entitled "Destructive Distillation," the lecturer dwelt chiefly on coal distillation with the resulting gas, tar, sulphur, &c. On the conclusion of the lecture which dealt with the subject very comprehensively, Mr. C. A. Fawsitt, the chairman, remarked that this subject of destructive distillation was more and more engrossing the attention of chemists. Considering the onward march of electricity in its application as an illuminant, the distillation of coal for gas was threatened with a very serious curtailment which would at once react on the supplies of the bye-products of distillation such as coal tar, &c., and it became a matter of question whether the time was not at hand when the distillation of coal would have to be undertaken for the direct purpose of obtaining what at present ranked merely as incidental or bye-products, but which by that time would themselves have risen to the grade of products-in-chief for which primarily the distillation had been engaged in.

AN ELECTRIC APPARATUS FOR INDICATING VERY SLIGHT VARIATIONS OF PRESSURE IN A CURRENT OF GAS.

THE apparatus, of which we give a sketch below, has been designed by MM. G. and L. Richard, for the purpose of indicating automatically slight variations of pressure in gaseous currents. It is very small but extremely sensitive, being capable of responding to variations of pressure which are no greater than the pressure of a column of water a few hundredths of a millimetre in height.

The essential features of this apparatus are as follows :—A metallic box is placed in communication by means of a tube, *t*, with the conduit through which the current of gas is passing.

The tube is closed by a clack-valve, *c*, made of light metal, movable around an axis, *a*, and balanced in such a way that when the pressure is lower than the limit for which the apparatus is set, it remains, closing an electric circuit, *i*. In this circuit a bell may be placed. A box, *b*, charged with



cotton wool prevents dust and similar matter from entering the mechanism.

Suppose a lowering of the pressure to take place, then the clack-valve, *c*, closes the orifice of the tube, *t*, and the circuit, *i*, is thus open and the current no longer passes.

The apparatus is capable of having its sensitiveness modified to suit any given circumstance.

This is not a mere scientific toy. It is capable of many industrial applications. For example, it may be applied in order to regulate ventilation, also to certain forms of slow-combustion stoves, &c.

In the issue of the *Comptes Rendus des Séances de l'Académie des Sciences*, Paris, for June 15th, MM. Richard give a full description of this apparatus, and indicate certain ways in which it may be modified.

AN ALTERNATE CURRENT POTENTIOMETER.*

MR. GEO. W. BLODGETT : I would like to ask if it makes any difference what kind of a lamp is used, or whether one must use some particular lamp for a particular instrument?

Prof. E. L. NICHOLS : The lamp, I think, is a matter of no consequence ; only in order to get the best result the lamp should be more than red hot. You will find the sensitiveness to increase as the brightness of the lamp increases up to a certain point. It is best to have a lamp the voltage of which is about that which is to be measured. Through a wide range of intensities in a lamp the accuracy is not materially diminished. Any constant current voltmeter can be used for reading the voltage on that side of the switch. In order that your result may be correct, you should have a constant current voltmeter which gives correct indications.

Prof. THOMSON : As to the degree of accuracy attainable in this way, if I remember correctly, some tests were undertaken some two or three years ago by us to determine how much variation was possible in a lamp ; that is, if you should drop or raise the voltage, what was the smallest increase or decrease of voltage suddenly brought on that would show in a lamp, and I think it was about one-tenth of a volt. It could be detected by watching the lamp very closely—simply putting in a resistance, and slipping it in and out quickly. We could detect about one-tenth of a volt, which, of course, would confirm the method.

Mr. WESTON : As I understand, the arrangement is that we are to have an incandescent lamp simply as an indicator —that the indicator lamp has to be brought from a normal value by a direct current, and then you are to pass an alternating current of unknown electromotive force through it. Is that the proposition ?

Prof. NICHOLS : Yes.

Mr. WESTON : And determine the electromotive force in this way ? I can say that that will work very nicely indeed. We have used that method in endeavouring to arrive at a somewhat difficult problem in connection with an alternating current instrument of great sensibility and portability. I think the method was used about three years ago. The accuracy is greater the greater the change, of course, in the electromotive force of current flowing through it. The method is undoubtedly susceptible of very close results indeed.

Prof. NICHOLS : I think that it will be found that there is a limit to the brilliancy of the lamp which you can use in practice, on account of the eye. If you have too bright a light, the eye is not susceptible to small changes. Probably there is a maximum brightness which should be used in order to give the maximum sensitiveness of the method. The change of the lamp will, of course, increase as you increase the intensity of the lamp. If you go to a point where the lamp dazzles the eye, the eye, by its decreasing sensitiveness, will overcome this. Our experiments, thus far, go only to confirm Mr. Weston's statement, that the lamp should be burned at quite a high temperature.

Prof. GEORGE FORBES : I would suggest that there is a very simple way of enormously increasing the sensitiveness of this method. As I understand it, the way in which you use it at present is to look at the lamp while the continuous current is serving it, and then switch it over to the alternating current and then judge which is the brightest, moving it rapidly back and forward. It seems to me that that method would be enormously more sensitive if you applied two lamps, and used them in a properly constructed photometer with a switch arrangement, which enables you to connect either of them with the alternating or continuous current. Thus you would adjust the potential of the continuous current until you get very near equality, but you would find that one of the lamps was always a little brighter than the other, owing to the sensibility of the lamp. You would then alter the distance of the lamps from the photometric screen slightly, so that on reversing the current you would get an absolute equality, and then you would be able to arrive at a much closer comparison, and it would not matter if there was a very slight difference in the illuminating power of the two lamps with different voltages. I feel perfectly sure that this would increase the sensitiveness of the method about tenfold.

* Abstract of discussion of paper on this subject by Prof. Geo. S. Moler, read at the General Meeting of the American Institute of Electrical Engineers, May 21st, 1891. See REVIEW for June 12th.

CHANGES OF VOLTAIC ENERGY OF ALLOYS DURING FUSION.

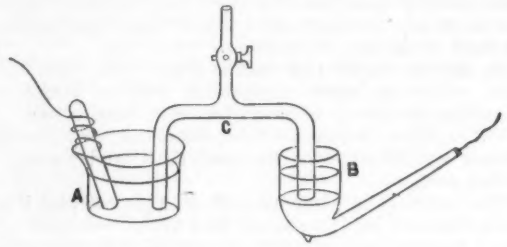
THE following is an abstract of a paper in the current issue of the *Philosophical Magazine*, by Dr. G. Gore, F.R.S., on the changes of voltaic energy of alloys during fusion.

It has been observed by Mons. J. Regnauld that liquid gallium is electropositive to solid gallium in a neutral solution of gallous sulphate (*vide Comptes Rendus*, June 10th, 1878). He states that "this categorical experiment renders manifest in a very simple case the influence exercised by the heat of constitution upon the energy of its chemical properties," and that "the available chemical work which a body possesses depends not only upon the specific nature of the atoms, but

also upon the total of calories which its maintenance in the physical state determines."

Dr. Gore's object was to ascertain whether, consistently with this observation, the change of physical state of an alloy from solid to liquid by fusion, and the large absorption of heat which then occurs, is usually attended by a correspondingly large increase of voltaic electromotive force, and whether the converse effect occurs during solidification.

The apparatus used in this investigation is interesting from its bare simplicity. In the following figure.



A is a glass cup.
B „ tobacco-pipe with a wide bowl.
C „ bent glass syphon provided with a tap.

A bar of the alloy to be examined was placed vertically in A, and a second portion of the alloy was melted in the bowl and some distance up the stem of the pipe, B, so as to exclude the production of thermo-electric currents at the junction with the connecting wire, and then allowed to solidify and cool.

The electrolyte, at atmospheric pressure, was poured into A and B, and a portion raised by suction into C, so as to connect the portions in A and B. The terminals of the portions of alloy were connected by iron wires with a suitable astatic galvanometer of 100 ohms resistance, and the needles allowed to settle at zero. Heat was then applied by means of a small flame to the bowl of B until the alloy in it melted, and the temperature of the electrolyte was raised nearly to the boiling point, the flame was then removed. The deflections of the needles of the galvanometer at definite intervals of time during the heating and cooling, and especially at the fusing and solidifying points, were carefully observed and recorded.

These electrolytes were used, viz. :—

I. 1 part by weight of absolute hydrochloric acid in 100 of water.
II. 1 part by weight of sodium chloride in 100 of water.
III. A nearly saturated solution of sodium chloride.

The experiments were carried out with the following alloys :—

I. Bismuth 70 parts, lead 40, tin 20, cadmium, 15.
II. Bismuth 8 parts, lead 8, tin 3.
III. Bismuth 10 parts, tin 3·5, lead 3·2, mercury 2·0.
IV. Zinc 1 part, mercury 7.
V. A tin amalgam $Sn_4 Hg_5$.
VI. Cadmium 1 part, mercury 4.

The observations were made at different temperatures. On applying heat it was observed that (1) the heated portion of the alloy became gradually electropositive to the cold portion up to its fusion point. (2) A more or less sudden increase of electromotive force occurred during the further heating of the alloy and the electrolyte up to the boiling point of the latter, and this sudden increase appeared to coincide in point of time with the melting of the alloy.

Substantially the reverse of these phenomena happened after removing the flame, during the processes of evolving latent heat and subsequent cooling.

Dr. Gore argues that the rapid increase of electromotive force must be due to the alloy and not to the electrolyte. He suggests the following explanation of the increase of voltaic energy during liquefaction, namely, that the molecules of the liquefied alloy are usually in a state of more active motion than those of the solid substances, partly because the liquid has absorbed more potential heat ; and that the suddenness of the increase of the current at the period of liquefaction is due to absorption of heat being promoted, and chemical and voltaic action facilitated by the sudden occurrence of convection currents in the liquid alloy.

A partial exception to the phenomenon of sudden increase of electromotive force during the action of fusion took place with No. VI. amalgam. The variations are shown by a curve in the original paper, and there is also a note relating to it in the *Phil. Mag.* for September, 1890, p. 228.

The experiments clearly demonstrate that charges of voltaic energy may be used in the above manner to detect physical and chemical changes in metallic alloys.

EXPERIMENTS ON THE ELECTRIC DISCHARGE IN VACUUM TUBES.*

BY ELIHU THOMSON.

I HAVE been much interested in the account of novel phenomena given under the title "Some Experiments on the Electric Discharge in Vacuum Tubes," by Prof. J. J. Thomson, inasmuch as several months ago I tried the same, or a very similar, experiment to that in which an induced discharge in a closed circuit vacuum receiver was obtained.

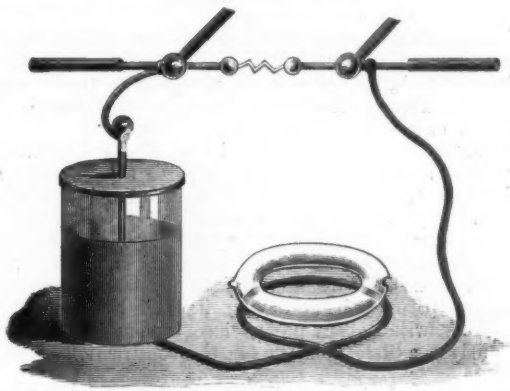


FIG. 1.—ELECTRIC DISCHARGE IN VACUUM TUBE.

Briefly, my experiment was performed with a closed ring made of a glass tube about one inch in diameter, the external diameter of the ring being about six inches. This was exhausted to a fairly good vacuum and laid alongside of a single turn of heavily insulated wire, which formed part of the discharge path from the outside of a Leyden jar, arranged to be charged and discharged rapidly by a Toepler-Holtz machine. It was found that at every discharge of the jar there was a discharge in the tube giving a band of light in the vacuous space. The accompanying engraving, fig. 1, shows the arrangement of apparatus as just described.

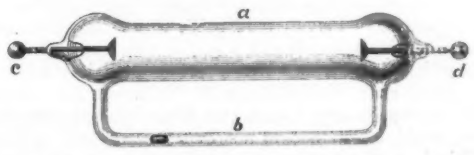


FIG. 2.—ELECTRIC DISCHARGE IN BRANCHED VACUUM TUBE.

It will be evident that to obtain the greatest value of electromotive force in the discharge tube the inducing turns should not exceed one, as otherwise the arrangement becomes a transformer, reducing the potential in the discharge tube. The wire used for the single inducing turn should be very heavily insulated and its turns separated, or the discharge may break through and, instead of going around the turn, short-circuit it. The potential induced in a single turn under these conditions of the experiment may easily reach 10,000 volts or more.

Curiously enough, the experiment of Prof. J. J. Thomson,

* *Electrical Engineer*, of New York.

in which a small pellet of mercury in an exhausted tube stopped the discharge, had its counterpart in my own experiments, as follows: I had constructed a two-way discharge tube, fig. 2. One branch, *a*, was large in diameter and the branch, *b*, was of barometer-tube section. Wires sealed at *c*, *d*, enabled a discharge to be passed. A small globule of mercury was placed in the tube and could be shaken down into the barometer tube and out into the large tube at will. Though the discharge would not always divide and pass through both tubes from *c* to *d*, it sometimes did; but the interposition of the mercury globule in the small tube stopped the discharge through it. Even without the mercury the discharge would often fail to pass, but reversing the coils of the Ruhmkorff coil used would often cause its derivation.

In one case, even when the mercury was in the small tube, the discharge passed, but the approach of metal objects near the tube would stop it temporarily; on their removal the discharge was resumed. This condition was so critical that it could not again be obtained, though efforts were made to obtain it. I have thought it well to record these observations, made independently, especially as the conditions were somewhat modified.

FRENCH SUBMARINE TELEGRAPHS AND THE CHAMBER.

AN extraordinary credit of five and a half million francs to meet the expenses of laying two cables, one from Marseilles to Tunis, the other from Marseilles to Oran, came before the French Chamber of Deputies on Wednesday of last week when a very lively discussion took place.

M. JOLIBOIS complained that the last Budget Committee, of which he was a member, had added to the Government project that these cables should be constructed at the Seyne factory. Why remove the adjudication? Why create a State industry? The Seyne factory did not manufacture the core of the cables, but only their coverings, and, in addition to other things, it was necessary to purchase a vessel to transport the cable before laying it. All that would be very costly, without any profit, since foreign States would not apply to a State industry for the construction of their cables.

M. PREVET insisted on the consideration of the intermittency of the work, for which apparatus would have to be acquired at great expense. It was evident that the wants of the French State would not suffice to keep the Seyne factory going. That was not all. The orders for raw materials which the State would not make with the prudence of a private enterprise would risk throwing the market into agitation and to cause false prices to prevail.

M. MILLERAND (the reporter) retorted that it was not a question of creating a State factory. The Seyne factory had existed since M. Cochery's time, and it had proved its vitality by laying, between France and Corsica, a cable 350 kilomètres in length. It annoyed certain persons who would render it useless because it worked more cheaply than private enterprises; this was shown when the repair of the Algerian cable was in question. Private enterprise, which was put forward so prominently, was only composed of two firms which were rather allied than rivals. Was a serious adjudication possible then under such circumstances? To reject the condition added by the Budget Committee, that was, construction at Seyne, would be to accord a subvention of two millions to the Telephone Company.

M. JULES ROCHE (Minister of Commerce) defended, from his side, the original proposals of the Government. It was clearly established that, even in not constructing the core of the cable itself, which private industry was alone in a position to supply, the transformed Seyne factory would spend about five millions for the sheathing and the operation of laying, which was so difficult; there would remain out of the credit asked for, only 500,000 francs to meet the necessary expenses to complete the apparatus and to purchase a new vessel, the *Charente*, which laid the Corsican cable, not being capable of dealing with cables of the length of those in point. Now, those expenses could not be estimated at less than 2,200,000 francs. On the other hand, the necessity of completing the apparatus of the factory and of fitting up a special vessel would delay the work for a year. England—which, out of a total 225,000 kilos of submarine cables, possessed 140,000, while France had only 6,000, and its colonies the remainder—also applied to private enterprise, and the most elementary prudence enjoined them to imitate her if they wished to ensure the independence of their communications. M. Roche's speech was received with loud cheers.

M. MILLERAND followed; but it was in vain that he insisted and opposed to the affirmations of the Minister the examination he had himself made at Seyne and of the documents emanating from the Ministry. He referred to the understanding which existed between the Telephone Company and the Ménier Company, and repeated—that construction by the State would save two millions.

M. ROCHE replied that besides those firms there was a third, which was about to establish, between Toulon and Marseilles, the factory necessary for cable construction. As to the expenses projected by the committee, they presented features against which it was good the Chamber should be on its guard.

The closure being demanded, M. PREVET accepted it provided it did not imply a sending back to the committee. He added that private industry did not ask for a subvention, but work.

By a majority of 277 votes to 211, the Chamber rejected the condition which the Committee had added to the project, and, by 297 votes to 156, it voted the credit, this meaning that the laying of the two cables would be put up to adjudication.

ELECTRICITY IN DENTAL PRACTICE.*

BY S. B. PALMER, M.D.S., Syracuse, N.Y.

IN a commercial aspect, dentistry has received its share of benefits from the introduction of electrical appliances. Small motors furnish power to run lathes in the laboratory, the engine at the chair, the fan for circulation of air, the electromagnetic mallet for condensing gold in filling, the mouth lamp for diagnosing for dead teeth, for the cautery, and for maintaining heat in the points of instruments while working plastic fillings.

The inventor and investor have supplied even many others not necessary to mention, and the limit is not reached.

The above benefits mainly consist in labour saving, and in comfort both to patient and operator. Electricity has in store for coming patients far greater and more lasting benefits than the profession has been able to give, because even the rudimental teachings of electricity have not been required in dental education; with less than this the points which here follow cannot be discussed or appreciated.

We will consider the effects of electric potentials between fillings and such electrolytes as come in contact with them in the mouth, be it softened tooth structure, food or fluids, under the head of Electro Dental Physiology and Therapeutics, better known in the profession as the "Electro Chemical Theory."

Within 18 years the writer has presented a score of papers bearing upon this subject; discussions have followed and points have been gained, in keeping with empirical practice, until the so called theory has been absorbed in practice, which is not saying much for the triumph of science in modifying practice. In justice I should say that the Philadelphia Dental College has incorporated the principles in a text-book, from which students receive instructions in the "Electro Chemical Theory."

The most prominent points consist in this:—That the saliva of the mouth, the food, condiments, &c., sustain the relations of a battery cell with its fluids. When any metallic substance is placed therein it, as in the ordinary cell, has its potential or polarity, be it a plate or filling. Whether the current is constant or intermittent, or whether it be injurious or not, depends upon conditions which every operator should understand, so as to anticipate results. Let us illustrate by gold fillings; gold, as all understand, is the choice of all filling material. It does not oxydize, wears well, looks rich, and pays well. Twenty years ago it bordered on quackery to allow that amalgam would preserve certain conditions of teeth better than gold; to day the student is taught to adapt

* New York *Electrical Review*.

the filling to the tooth, in most cases without giving any scientific reason. The writer claims that gold fillings in the mouth come under the law as described in electro kinetics, relating to elements or plates when plunged in a battery cell, viz., of a higher potential than that of its surroundings. The effect of the current or electrolytic action therefrom becomes injurious to the tooth bone in contact, under the following circumstances :—When tooth structure is so poorly calcified or is wanting in the lime element that it becomes a conductor, by reason of the fluid or moisture it contains, it becomes an electrolyte, in proportion to the conducting fluid entering into the compound. It so happens that normal tooth bone contains nearly two thirds inorganic or non-conducting matter, a large portion of which is of lime or of alkaline nature, which is readily dissolved by acids. The one-third is composed of organic matter of the nature of cartilage, containing organs of sense or nerve fibre. Teeth composed of these proportions, or even slightly less dense, may be safely filled with gold, for which there is no better material in use. But we find the teeth of children which early commence to decay, so soft or so nearly representing cartilage that preservation by filling with gold would be an impossibility, an operation violating well known electro chemical laws. Modern practice recognises the necessity of using non-conducting fillings until the teeth mature. And yet the foundation principles for so doing are not given. I have not a word of complaint that the "electro chemical theory" has been received so slowly. There have been two potent hindrances; first there is no *line* up between electrical science and dental science. The writer well knows the difficulty of presenting the one word *potential* in a manner to be understood by those who know not the rudiments of electrical science, and not less is the other hindrance mentioned, prejudice; because the teachings at first were against the highest practice of the times. Eighteen years ago, gold was considered almost a universal filling, while amalgam was despised, together with those who advocated its use. It will not take as many minutes for the reader to understand the relations of the two materials for teeth preservation, as it has years for some of the older members of the profession.

Let us dismiss the better class of teeth with the popular idea that gold *is* the best filling material, and consider teeth of low grade, such as are known to decay around gold in a few years. The first effect where filled with gold is from a thousand changes, from heat or cold, the result of which is to devitalise the surface in contact with the filling, which decomposition becomes visible by the dark shade seen through the enamel; this lining is moist and becomes an electrolyte according to molecular mobility; the acid resulting therefrom finds its affinity in the lime salts of the structure which gives space for fluid circulation. Gold, as a filling material, imparts no antiseptic properties, it is only to fill the cavity, to displace fermenting substances.

Amalgam, while it is not to be recommended for its appearance, does supply properties that gold never does. There is less difference in its potential. With the positive elements, it gives off oxides and sulphide, which are lodged in the bone in the spaces from which the lime has been dissolved, thus bringing the walls of the cavity to the same potential as the filling, when the current ceases without decay. In practice great disturbances occur when gold fillings are placed in close relations with base metals. With a knowledge of galvanic currents, all such excitement may be avoided; without such knowledge, all is guess work. Filling teeth has reached its highest elevation in mechanical skill, advancement must now be looked for through science. One of the methods most apparent is *insulation* by varnish, which will fill the spaces in the porous bone, instead of using the sulphide mentioned. This is being done to a limited degree, but not taught, as it will be from a *potential* standpoint. The writer speaks from personal experiences rarely attained. Having at the outset a fascination for electrical science and being obliged to wear an artificial denture, which, from time to time, has embraced silver, gold, rubber, aluminium, &c., together with metallic fillings of various kinds and compounds, some of which have been combined for scientific purposes, has given practical knowledge that could not be obtained by other means.

By cultivation and observation, currents are readily detected between gold and other metals when not in the same teeth, so to speak; the mouth furnishes a galvanometer almost as sensitive to taste as that of the "frog's leg" is to sight. When the tongue bridges over or closes the circuit from fillings of different potentials, work is done on the line. Patients cannot describe the symptoms, none but an electrician could diagnose a case, nor can the subject be discussed by those having no such experiences.

I claim no honours for the advanced position set forth. The object of appealing to the *Review* is to protect the dental profession against false positions in electrical science; therefore, I kindly invite criticism that the doctrines may be purely scientific.

OBITUARY.

WILHELM WEBER.

A FORTNIGHT ago we announced in a brief note the death of Wilhelm Weber, and we now extract the following compendious notice and illustration from *La Lumière Electrique*, signed by M. Chas. Baye :—

Before entering upon the many claims of the *savant* to the gratitude of the scientific world, we wish to express our admiration for the nobility of character of the man, who, at the risk of compromising his career, never acted against his convictions. We are all the more happy in being able to pay him this posthumous homage, since we can add to it the personal remembrance of the affectionate reception we met with when we were admitted to his course of lectures.

We still preserve a very faithful and particularly clear recollection of the time spent in the life of the German Universities, where the pupils are brought into close association with the master, and so learn to fully appreciate his worth and to attach a greater value to his teaching. Above all, with a professor like Weber, and lectures into which he put so much earnestness that he ended by identifying himself, so to speak, with the experiments which he was explaining, the impression made is one never to be forgotten.

Weber was born on October 24th, 1804, at Wittemberg, in the kingdom of Saxony. He was the second son of Michel Weber, the famous theologian. His two brothers, Henry

GAUSS AND WEBER.

and Edward, distinguished themselves by their physiological researches. The elder, especially, whom he assisted, became famous for his researches on the nervous system and on the organs of hearing. He commenced his studies at Halle, in the Pædagogium of the orphan school at Francke. He was still at the university when he took part in his brother Henry's studies. In 1825, he published jointly with his brother, a theory of undulations. Two years later, he advanced his thesis on the theory of reed-pipes. Immediately after, he was appointed assistant professor at the very university where his father was professor of theology. In 1831, he was called to the University of Göttingen to take the chair as professor of physics.

This chair had been previously occupied by Lichtenberg, the physicist, whose name immediately associates itself in our minds with the name of those images by means of which Lichtenberg rendered visible the two kinds of electricity of a Leyden jar. It was in this famous little Hanoverian town that the greater part of Weber's scientific life was passed,

although for political reasons he was deprived of his seat for a certain time.

When Weber was appointed professor, the observatory of the university of Göttingen was directed by Gauss, the great mathematician, who, although more than 60 years old, was full of youthful ardour. Gauss and Weber having been brought together by Alexandre de Humboldt, were soon great friends. The studies in electricity and magnetism which captivated both, and which they pursued in common, were the commencement of a fruitful collaboration. Gauss himself thus describes the manner in which he made Weber's acquaintance. "We were attracted to one another," said he, "as the magnet attracts steel."

In the course of their researches into terrestrial magnetism, which were rendered famous by the application of Gauss's classical method, the two scientists conceived and established in 1834, between the physical laboratory and the astronomical observatory, the first telegraph that really worked.

The domain in which Weber's genius was chiefly exercised was that of electro-dynamics: the traces left by his labours in this branch are ineffaceable. His apparatus, which have remained the standard ones, the methods which he instituted and the theories which he developed, keep their place at the head of the science of electro-dynamic phenomena as do the finest experimental researches of Faraday.

Weber's greatest achievements are having subjected to calculation the complex phenomena of electro-dynamics, having instituted systems of absolute measurement, now universally employed; having been the first to determine and measure the relation between the units in the different systems, and having thus opened the way to one of the finest discoveries in the domain of the unity of physical forces—the electro-magnetic theory of light.

Weber's *Elektro-dynamische Maasbestimmungen* show the gradual development of his electro-dynamic theories. The new phenomena discovered within the last few years only tend to confirm the sagacity and accuracy of this master mind. It is truly remarkable that, at this period, Weber should have succeeded in summing up in one single formula all the elementary, electro-dynamic and electrostatic forms of action, and even universal attraction.

Since 1865, Weber has been on the list of members of the Académie des Sciences, Paris.

It is to be desired that the name of Weber should be added to those of Faraday and Ampère in the list of names connected with electrical units.

ELECTRICITY IN THE ART OF TANNING.

III.—*(Conclusion.)*

IN endeavouring to trace the change taking place in the hides during the absorption of tannin Messrs. Rideal and Trotter ascertained that the percentage of water present in the well drained hide gradually diminished as the tannage became more complete. A gradual increase in the specific gravity of the dried product was noticed. They also carried out some exhaustive experiments upon the content of nitrogen of finished leathers and the weight of the tannin absorbed by fleshed hides. In the original paper tables are given showing the results obtained, but they are more especially interesting to chemists and need not be referred to in detail here.

A very large amount of tannin was absorbed during the experiments which was not present in the finished leather, and Messrs. Rideal and Trotter are of opinion that this is due to the large portion of the tannin consumed being deposited on the surface of the semi-permeable membrane, and subsequently being removed when the leather is washed during the finishing process.

In some of our recent issues we have drawn attention to the researches of Ostwald and Tamman concerning semi-permeable walls or membranes. They have observed that a deposit of copper may be found in the above way on the surface of a semi-permeable membrane of copper ferrocyanide, and it would seem probable that after the gelatine-tannin compound is formed in the hide the deposition of tannin continues, but on the *surface only* of the leather. The experiments, moreover, go far to establish that when tannin is employed the conversion of the hide into leather is due to a combination or condensation of the gelatin and the tannin.

In fig. 3 the daily absorption of tannin from the liquor in the experimental tannage by Groth's system is shown, in which it will be seen that the rate of absorption gradually

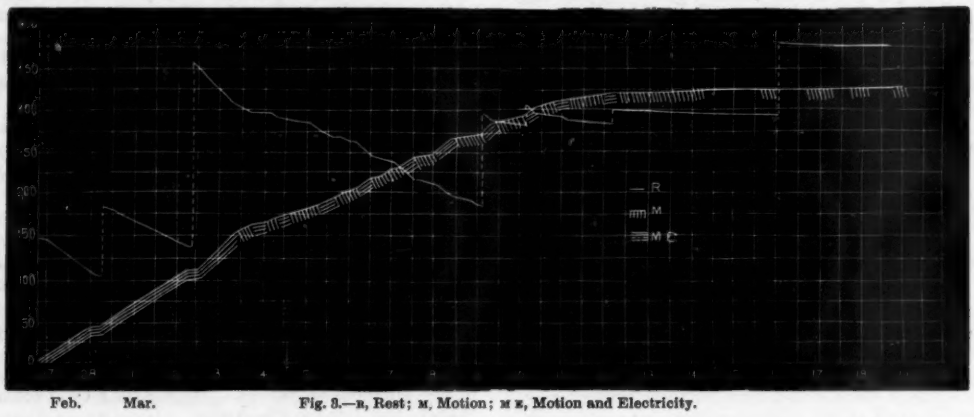


Fig. 3.—R, Rest; M, Motion; M E, Motion and Electricity.

diminishes as the hide becomes saturated with the tannin and finally becomes so small that the ordinary permanganate valuation of the liquor is useless for estimating the change.

In fig. 4 the daily readings for a similar experiment are plotted out, and show analogous results. The readings were, however, discontinued on the eleventh day, although the

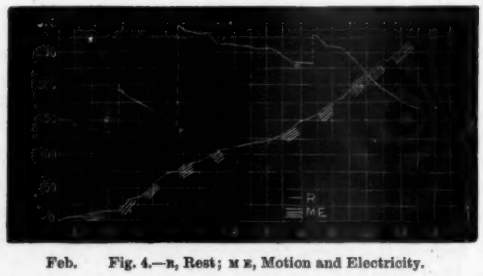


Fig. 4.—R, Rest; M E, Motion and Electricity.

quantity of tannin absorbed by the hides used in this experiment was not sufficient to completely tan them. They were subsequently finished in another vat.

From the foregoing results we have sufficient data to establish the qualitative fact that the combined action of the

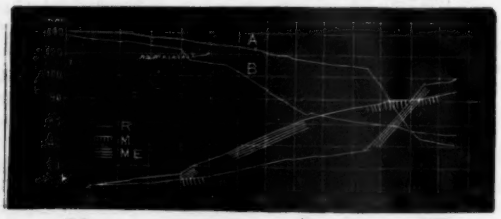


Fig. 5.—A, Decrease of strength of liquor in vat; B, Decrease of strength of liquor in vat; R, Rest; M, Motion; M E, Motion and Electricity.

motion, and the electric current considerably hastens the rate of tannage.

It was of interest, however, to ascertain, if possible, what

was the average rate obtained when the hides were slowly rotated in the pit and when no current was passed through the liquor. A comparative experiment was made to establish this point, the results of which are shown in fig. 5. Two circular vats were employed, A and B, containing 1,600 and 2,400 gallons of liquor respectively, made up to approximately the same strength. A batch of hides which had previously been limed, unhaired, and fleshed under the same conditions, was divided into two portions, whose weights were in the ratio of the volumes of the liquor in the two vats, so that the loss of tannin per unit volume of the liquor is equal to the absorption of tannin per unit weight of hide in each vat. The liquor was analysed at the commencement of the experiment (February 14th, 4 p.m.), and the hides remained suspended in the liquor, without any motion or electric current being applied to them for 44 hours. Samples of the two liquors were analysed, and the rate of absorption in each vat deduced and found to be practically identical.

The subsequent treatment of the hides in the two vats was so arranged that the hides in vat (A) should be subject to the joint influence of motion and electric current, whilst those in vat (B) were under the influence of motion alone. The experiment was then repeated for a longer time, and after an interval of rest the conditions were reversed, the hides in vat (A) being subjected to motion alone, and those in vat (B) to the joint action of motion and electric current.

The results are plotted together in fig. 5, where the upper curves show the gradual loss of tannin from the liquor and the lower curves are calculated from these to show the quantity absorbed by the hides. (As during these experiments the liquors were not strengthened, the lower curves are the images of the upper.) From the slope of the lines the relative rates can be obtained.

The following table summarises the above results :—

COMPARISON OF THE RATES OF TANNING.

Kind of tanning.	Total loss in parts per 10,000.	Total time in hours.	Rate.
Ordinary tannage	12·8	88	0·145
Rest after motion and electric current	15·3	56	0·273
Rest after motion alone... ...	15·7	56	0·280
Motion after electric current ...	8·6	24	0·360
„ alone	18·8	38	0·490
„ and electric current ...	53·6	38	1·420
Electric current after motion ...	59 0	24	2·470

Thus while the initial rate in vat 1 was 0·163 parts per 10,000 per hour, and 0·104 parts per 10,000 per hour in vat 2, when a current of electricity and motion was applied to vat 1, and motion only to vat 2, the rate of loss in vat 1 rose to 2·43 parts per 10,000, and in vat 2 to 0·63 parts per 10,000.

After an interval of rest, vat 1 showed a rate of 1·36 parts per 10,000, and vat 2 a rate of 0·52 parts per 10,000. It is to be noted, however, that the apparent falling off in the rate in vat 1 may be due not only to the gradual diminution as the tanning proceeds, as already referred to, but to the electric current during the night of this experiment being smaller than during the day, or possibly interrupted for some time, as no electrician was controlling the experiment during the night in question.

After another interval of rest the conditions were reversed, motion being alone used in vat 1, and motion and a current of electricity simultaneously in vat 2. The rates of loss were then found to be 0·36 parts per 10,000 per hour in vat 1, and 2·46 parts per 10,000 per hour in vat 2, thus confirming the previous figures and proving that the vats or proportions of liquor and hide employed in each were not affecting the comparison. The average values thus obtained were in the proportion of

Ordinary tanning.	With motion.	With motion and electricity.
0·133	0·503	2·08

Or the rate of tanning under the combined influence of electricity and motion is four times faster than the rate when motion alone is employed and sixteen times faster than when neither is used.

Messrs. Rideal and Trotter did not try the effect of a current of electricity on the hides when at rest, although no doubt the tanning rate would be similar to that when motion is employed, as the hide when at rest would not be uniformly influenced by the flow of current through the vat, and the leather produced would therefore be unequally tanned.

It should be noticed that these rates were obtained with motion of the kind produced by the first kind of machine, and that no doubt other rates of tanning would be observed under the influence of other kinds of motion; and if no provisions were adopted for preventing the hides from being in contact with one another, it is safe to assume that the rate would be considerably less, as the circulation of the liquor to every part of the hide would be prevented.

The paper was concluded with some theoretical explanations and deductions. The authors said that the original suggestion of Grothius in 1805, with its chain of molecules and bonds, its pairing and unpairing, formed a very fair working hypothesis and has been gradually developed and elaborated until we are to day confronted with a very serious complication of theories. Helmholtz had suggested that there is no tearing apart of the molecules, but that the work must be done in separating an atom from its electrical charge, or in removing electricity from an atom of high specific attraction and giving it to another lower in the scale. Clausius considered that the molecules are always changing partners, that dissociation, in fact, is always present to some extent, and that the effect of the electromotive force is to give direction to movements which are already going on. Arrhenius considers that dissociation is complete in very dilute solutions, but Traube maintains that such a view upsets our conceptions of chemical affinity, and makes the convenient assumptions as to the nascent state impossible, and flatly contradicts the theory of hydration.

The idea of a nascent state has been to a large extent given up by chemists, but the ions are undoubtedly occasionally liberated in a form in which, although they do not readily combine with the other matters in solution, and are in a self-combined state, *e.g.* ozone, they are in a very energetic condition. From *à priori* considerations this nascent state or the resulting facilities for combination which arise from the cause whatever it is called, might be expected to facilitate the operation of tanning in the same way that it affects the operations of bleaching and treatment of sewage. But although the tannins are molecules of some complexity there are no grounds for supposing that dissociated molecules react with the gelatin of the hides, and we have no proof whatever that any such dissociation takes place in the tanning process.

Turning to the question of dialysis and osmosis, we find dialysis to be a form of diffusion to which electrolysis has been compared by Wiedemann, who showed that the conductivity of an electrolyte may be considered as depending on the coefficient of diffusion of the components through each other. Dialysis is a selective diffusion and is undoubtedly facilitated by the passage of an electric current, and it is easy to see that such an action must be extremely advantageous in the slow process of tanning, which is probably retarded enormously by the superficial coagulation which takes place almost at the moment of first contact of the green hide with the tanning liquor.

Theories of dialysis are at present incomplete, but Van't Hoff's law of osmotic pressure and our knowledge of the migration of ions indicate the direction from which a satisfactory theory of the process may be looked for.

In the meantime the facts which have been established are of a very different order, so widely different indeed that the hypothesis of osmosis and observations of the migration of ions are alike useless. Dr. Lodge's experiments with dilute sulphuric acid gave a velocity of about $\frac{1}{315}$ cm. per second for H, and $\frac{1}{3000}$ cm. per second for SO_4 with jelly and a slope of potential of 1 volt per cm., the velocity of Ba was $\frac{1}{83000}$ cm. per second and Cl and Br $\frac{1}{41150}$ cm. per second. But with slope of $\frac{1}{10}$th of this, *i.e.*, about 1 volt per cm. the rate of progress of tanning is only about 0·025 cm. in 100 hours, or $\frac{1}{13000000}$ cm. per second, or $7\frac{1}{2}$ inches per annum. It thus seems necessary to attribute part of the hastening effect to the direct action of the electric current upon the suspended hide.

Helmholtz and Ostwald have given considerable attention to the resistance of electrolytes and it is pointed out that

the degree of dissociation can be determined from the conductivity. Arrhenius concludes that the resistance is greater as the ions are more complex; and the tanning molecules are considerably more complex than any compounds that have yet formed the subject of careful experimental work. Not only have we a complex solution, but it is admitted that with weak currents secondary actions are likely to take place at the electrodes, and it is only with strong currents that the real ions are liberated. The fact that the rate of absorption of tannin distinctly diminishes with even 4 ampères shows that if any chemical action be involved it is probably some secondary action of considerable complexity, and that, therefore, there is no need for attempting to explain the process by an electrolytic breaking down of the tannin molecules.

Although it is difficult to advance any definite theory as to the effect of the passage of the electrical current upon the process of tanning, the increased rate is obviously due to the current heating the chemical union between the bodies which are in a condition to combine. It is well known that chemical combinations, which only take place at elevated temperatures, can be induced to occur at ordinary temperatures, when an alternating current is passed through the mixture of the two bodies. Amines combine with aldehydes in this way, and Meritens English patent 16,947, 1889, has proposed to bring about etherification and so effect the quick ageing of spirits by the help of an alternating current.

Dr. S. Ehrmann, of Vienna, has also recently shown that a moist skin absorbs salts very rapidly from their solution when an electric current passes, and Wagner has also proposed to administer cocaine by a similar process of cataphoric medication. In Ehrmann's experiments, a current of 10-20 milliampères was passed from zinc electrodes through a solution of methylene blue, in two cups in which the hands of the observer were immersed, blue spots appeared on the back of the hand in the anode vessel and none on the other hand in the other vessel. The absorption was most marked where the hair and fatty glands are situated, and thus throws light on the fact that in tanning the process is most rapid on those parts of the skin, and that the electric current has no doubt a distending effect upon the pores of the skin as indicated by an earlier experiment. Lithium chloride is similarly absorbed by endosmosis through the skin, and Edison has shown that gouty secretions in the fingers are speedily dissipated by the prolonged action of currents of 20 milliampères. H. N. Lawrence and Dr. Harries have obtained similar results (*Soc. Arts*, March 11th, 1891). Dr. Rideal and Mr. Trotter believe that the hastening of the tanning process is of a similar character, and they draw attention to these experiments as analogous, if not confirmatory, of the explanation of the process which they tentatively advance.

CONCERNING LIGHTNING RODS.*

By ELIHU THOMSON.

In my opinion the lightning rod, contrary to the opinions put forward and even advocated in the books, does not have any considerable effect in conducting off discharges from the clouds silently, for the reason that the development of the conditions of the discharge from the cloud to the earth is oftentimes too sudden to allow any rod or rods to effect this work of conduction in a silent manner. The cloud ordinarily during thunderstorms is moving rapidly and the lightning strokes are found most frequently where the densest rain exists, and it is easy to see that a building may suddenly be drenched with rain and the conditions for a stroke brought about at such a rate that a lightning rod or rods could not ward off a discharge by conducting the electricity silently to the earth. In such cases what is more likely to happen is this, that the highly charged cloud existing over the neighbourhood of the building provided with a rod will, if the conditions are favourable, suddenly discharge itself into the rod and the discharge be thus carried to ground. The actual area which is protected by a church spire provided with a lightning conductor has never been satisfactorily determined, but it is probably at least equal to that of a circle whose radius is equal to the height of the spire or chimney above the top of the building to be protected. All that I have said in relation to the effectiveness of the lightning rod implies of course that it be properly put up—that is, put up with a knowledge of the conditions of the service which is to be had from it—and that it be thoroughly connected with the ground at its lower end. The most perfect lightning protection is obtained when the building is virtually in a metallic cage, the parts of which in connection with the earth are very thoroughly grounded or connected with the moist stratum. Such thoroughness as this is, however, not necessary. With even a large building the carrying of a conductor down each corner and grounding it as above mentioned would be sufficient. I think it is pretty generally conceded that one-half inch iron rod has never been known to be injured by the passage of a lightning discharge through it, and that such rod conducts the discharge freely enough for the purpose. A lighting rod made of galvanised iron pipe, say, 1 inch pipe, used with the screw joints well secured and painted so as not to rust at the joints, would be about as good a conductor as could be desired. A flat strip of copper securely tacked to the building and running down its corners, the dimensions of the copper being, say, $\frac{1}{16}$th inch thick by 1½ inches wide, would also answer, and is in many respects a good form of conductor. If the metal, aluminium, becomes cheap enough, I think an iron bar covered with this metal would be an excellent conductor on account of the small liability of the aluminium to rust.

A discharge of a cloud to earth in a lightning flash is simply the relief of the electrical pressure, an action which is repeatedly brought about by this difference of pressure continuing during the storm. There is in the cloud atmosphere a formation of raindrops going on which causes a condensation or accumulation of electricity, and this again and again brings the cloud to the condition of discharge, and again and again it may strike in relieving the difference of pressure. That it strikes in one place, or, as it were, splits the air at one point, simply indicates that the line of discharge, or line of the lightning stroke is the axis of a disturbance which has taken place between the cloud and earth, and it is on this line or axis that the energy and the destructive effect of a discharge will be concentrated, although it must by no means be thought that the effects of the lightning stroke are confined to this path.

As regards the cause of the existence of the pressure or electrical charge in the cloud I believe it has not been found that any single cause exists which can be regarded as producing all the effects. An accumulation of electricity in a cloud seems to be concomitant with a sudden condensation of vapour which takes place on the cooling or rarefaction of vast bodies of moist air. If the air before the condensation was in any way electrified, however slowly, the condensation or conversion of the cloud into drops of water would be followed by the existence of an electrical charge in the cloud. It has been supposed that the growth of vegetation, combustion, decay, evaporation, friction of dust particles carried up by the wind and such actions might give rise to electricity in the atmosphere. However, any portion of the atmosphere so electrified, when carried to an elevation above the surface, or becoming part of an uprising current, the moisture in the air condenses at the higher altitudes and forms the thundercloud. This theory accounts for the fact that thunderstorms are very apt to follow hot days in the summer. The layer of air on the surface or near the surface of the ground gets highly heated by absorption of the sun's rays, and, being rendered light by the high temperature, it rises in great columns to altitudes which cause condensation of the water to take place. This makes a fog which very soon may begin to collect into drops and so give rise to rain. The action is so sudden that whatever electricity is present is, as it were, caught in the cloud and held there as a charge, and the gradual coalescing of the fine particles of water in the moist air into raindrops reduces the amount of surface on which the electricity is found, and therefore increases its pressure. This explanation is the best that I can give in popular language.

Concerning the action of a lightning rod in saving a building from harm, this can be briefly stated to be the mere interposing of some good conductor in the path of the lightning discharge, so that the charge can be carried to earth, or the electric strain relieved, without the necessity

* *Electrical World.*

for following poorer conductors, which, if traversed, would be torn to pieces or destroyed. More scientifically, it may be stated to be the provision of a path or centre of action for the discharge in the vicinity of the building of such a character that the discharge selects it in preference to forming a centre of discharge or path for itself through the building, which may be made of materials not able to carry the discharge without destruction. The concentration of the energy of a discharge on ordinary building material, such as wood, stones, brick or plaster, gives rise to destruction from the mere fact that these substances are not capable of conveying the energy without being highly heated. If wood be suddenly heated the watery vapour in it forms a gas and explodes it. The destructive effects, then, of the electrical discharge are due to expansion of gases or the production of vapours within the material damaged.

The effectiveness of lightning rods depends, I think, not alone upon their cross section nor alone upon their surface. It is as much a mechanical as an electrical question. There needs to be a sufficient cross section of metal not to be melted by any discharge, and it is best that the metal be made in the form of a pipe or flat strip, since the tendency of the lightning discharge is to follow the surface portion of the conductor. This is due to the fact that it is an extremely quick discharge and may take upon itself an oscillating character. This means that each spark which connects earth and cloud is not a stream of something running in one direction, but merely a core or axis for a set of disturbances or reliefs of pressure which may act alternately in opposite directions during the short intervals through which the flash lasts. The oscillating action may be illustrated by fastening the end of a thin steel rod and bending it by carrying the free end to one side. This, if let go, will be followed by a series of oscillations made very quickly, but which are akin to oscillations of a pendulum. The relief of electrical pressure is in lightning so sudden as to result in the action of relief going too far, after which a relief in the opposite direction ensues, back and forth, until all of the energy of the discharge has been used up in the form of light and heat. I am convinced from my own observation that very many lightning discharges, particularly those which pass over great lengths of cloud, are more apt to be discharges of some duration. Observation over a long period of years has led me to think that it may be possible that the discharges in some instances have a measurable rate of progress from cloud to cloud and perhaps to earth. The photographic plate which is being more and more applied to the study of lightning discharges, will some day resolve this doubt.

I am asked whether I agree with the ideas advanced by Mr. N. D. C. Hodges in his paper on this subject. He argues that because he has failed to find cases of damage by lightning when the conductor has been dissipated or vapourised, that all lightning conductors should be made so that they or a part of them will undergo dissipation on the passage of a lightning discharge and so use up the energy of the charge in the formation of vapour. Now, as lightning does damage only when it avoids the lightning conductor and passes through the building, I fail to see why if it should avoid Mr. Hodges's dissipable affair it would not do equal damage. When the discharge confines itself to the lightning conductor, dissipable or not, such conductor protects. The fallacy in his idea is that it supposes the work of the discharge to be confined to that very short length between the top of the building and the ground. As I regard it, the giving out of energy of a lightning discharge is by no means confined to the building which is struck or to the lightning rod which carries it, but on the contrary, this portion of the path receives but a small fraction of the total energy. Whoever has looked out upon lightning during a thunderstorm and watched the vivid streaks of fire connecting the most distant parts of the clouds with the earth will be able to realise what I state to be the fact, namely, that very much the larger part of the energy of a lightning discharge is consumed in the atmosphere itself in producing that vivid light and the intense heat which mark the path of the lightning. When we put a lightning rod of ample dimensions and proper construction on the building, with one end in the ground and the other on the roof we have virtually brought the earth up to the roof, and shortened the length of the lightning discharge, confining it to that path which may produce light and heat in the air without damage to the building. We thus have all that elongated path in the air still to use up the energy of the charge without any other damage than the terror which comes to nervous people. To provide a lightning rod which is partly or wholly destroyed during a thunderstorm, or which is to be rendered ineffective by dissipation, as Mr. Hodges does, is to invite another discharge coming later to do all the damage it can without any provision for avoidance. No one, indeed, desires to replace a lightning rod during a thunderstorm, and no one desires to renew a rod at all if he can avoid it, or to renew any part of it, as it is well known that a lightning rod of all things is the last thing thought of until a storm comes which demands its efficient service. I would say in conclusion, therefore, that I do not believe that the simple efficient lightning rod provided by Benjamin Franklin and suggested in connection with his first experiments with the kite and key is likely to be superseded except in the matter of improvements in the details and its disposition about the building or the intelligent placing of the rod or conductor where it is most needed.—*Abstract of paper in the "Electrical World."*

THE ELECTRIC LIGHT AT BUDAPEST.

[FROM OUR OWN CORRESPONDENT.]

Conditions under which wires and cables may be laid in the territory of the capital, Budapest, under the supervision of the authorities, for the purpose of lighting and the transmission of power :—

Section 1. A concession for electric lighting can be granted only to a native company having its seat in Budapest.

Section 2. Wires or cables cannot be laid in the public sewers, but must be placed in special channels situate underneath the footway, and consisting of concrete, masonry, metal, or other materials possessing a sufficient resisting power, and in every case in accordance with permissions to be obtained from the authorities.

The place of the lead, the depth of its position, and its maximum external diameter will be determined in each case by the authorities, with reference to mains which are already laid beneath the footway, and to the leads reserved by the authorities for their own purposes, in which case the leads reserved for a future municipal electric installation will be laid nearest the surface of the footway.

In case the metropolitan authorities do not grant the application for laying leads along certain streets or lines of road (whether from want of room or other reasons), the projector has no right of appeal.

The placing of wires or cables in the carriage road can be granted only at street crossings.

At such crossings the leads must be placed at least at the depth of 1 metre below the level of the pavement.

The leads are to be placed under the footway along the houses at both sides of the street, so that in case of the service wires into the houses, there will be no need to break up the body of the street.

A departure from this condition is permissible only if the street is not wide enough for placing leads on both sides.

To facilitate testing the leads, shafts must be constructed at certain distances, in such a manner that in case of an injury to the leads, or any other fault, the wires and cables may be withdrawn through the shafts without breaking up the pavement and again replaced.

The construction of the shafts is determined by the authorities, and they must always be provided with doors covered with asphalt.

Wherever a cable crosses the street, a shaft must be constructed at one or other end of the crossing.

If the lead crosses any wide or crowded street, and especially in any street paved with concrete, shafts must be provided at both ends of the crossing. At the wish of the authorities these shafts must be connected by tunnels, the model of which will be supplied by the authorities.

If this gallery is crossed by a sewer, the cable must be laid from end to end above the sewer. In case the difference

of height between the level of the street and the top of the sewer is insufficient, the cable may be conveyed through the sewer, even in the pavement.

If several companies obtain simultaneously permission to make use of the footway, the authorities may permit the cables of the different undertakings to be laid in one common gallery, but the arrangement and the dimensions of the leads as well as the other conditions for the use of such common channel require the consent of the authorities.

Section 3. The wires and cables must be laid at the distance of at least 1 metre from the extreme frontage of the houses. The space within this distance is reserved for the municipal leads, which may ultimately be laid, in case it is decided by the authorities that :—

1. The place is suitable for the purpose.

2. The wires or cables, with reference to the intensity of the current and the thickness of the insulating coating, can be used without interfering with personal safety and without injury to the various departments of public service.

In case of narrow footways, this width of 1 metre can be reduced in particular cases, according to the discretion of the authorities.

Section 4. The wires leading into the interior of the houses are always to be laid between the main cable and the fronts of the houses or the leads connected with the main cable.

Except the branches of the wires, all the arrangements must be effected externally to the body of the streets, *i.e.*, the carriage way.

Section 5. If transformers are used they must be placed outside the body of the street.

Section 6. Before the commencement of such works, which have to be carried out within any part of the leads placed in the carriage roads, the plans referring to such operations must be submitted in triplicate to the metropolitan authorities for their sanction, and the work may not begin until their sanction has been obtained and certified to the undertaker.

For the preparation of the plans the requisite facilities will be at the service of the undertaker, *e.g.*, plans of the gas and water mains, plans of other electric leads previously conceded, as also of the sewers and their branch pipes leading from the houses, &c. From these the requisite data may be obtained, though the authorities will not be responsible for any possible errors, inaccuracies or imperfections of the data placed at the disposal of the undertaker, or for any difficulties which may arise in carrying out the works.

Section 7. The undertaker is bound to keep prepared the plans of the conductive net on the scale of 1 : 720 in which all the ramifications leading into the buildings, the number and the kind of the lamps actuated by the leads, or in case of the transfer of power, the motive power are shown distinctly and accurately.

This plan must be supplemented by a statement of the quality of the cable, its purpose, its dimensions, and other local data considered necessary by the authorities.

The special situations of each single point of the conductive net, especially at the ramifications of the sewers, the water and gas mains, and at the street crossings, must be shown by detailed sections on a double scale.

Each plan must be prepared in triplicate, revised half yearly and kept in evidence.

Section 8. In case of any work to be executed in existing leads, it must be agreed on with the engineer of the ward in the inner city and in the outer city with the municipal engineer's office three days before the operations are taken in hand.

The same procedure is to be observed when setting leads in action or in case of repairs.

An exception to this rule is permitted when searching for some suspected damage, in which case the announcement may be made on the same day.

The undertaker is bound, in case of need, to bring any intended alterations in the leads to the knowledge of the authorities through the medium of the city engineer's office.

Section 9. If either when the lead is first laid down or by occasion of subsequent repairs or alterations, the pavement has to be broken up, the undertaker is bound to put it forthwith in order again, and to see that it is again made fit for traffic. Each such piece of work must be announced, and must be reported at the engineer's office or to the ward engineers. The pavement must, however, be made good by the undertaker who has first laid it down, if within the term of his agreement.

Section 10. The undertaker, in executing such works, is bound to observe all official regulations as regards the construction of the streets or other public works therewith connected.

He is also bound to observe all valid statutory regulations in relation to the construction and maintenance of the conductive net and decided during the time of the concession.

Section 11. The above concession, which holds good for . . . . reckoned from the date of signature, is given without monopoly or privilege, as the capital reserves to itself the exclusive right to grant similar concessions to other undertakers, even for streets for which a concession has already been granted. In this latter case the undertaker is entitled to all the general advantages and favours which the metropolis has conceded to the undertaker of the conduction to be subsequently installed.

Section 12. The metropolis, Budapest, reserves to itself the right to command the relaying of the leads, or their entire removal, or even, in case of need, the relaying and the removal of single parts of the conduction at the cost of the undertaker, without any claim to compensation on the part of the latter, if the general interest or the interest of the town shall require it.

Save in case of *vis major*, the undertaker is to be summoned to carry out such relayings or removals, at least five days previously ; and if he does not comply with this demand the city is entitled to carry out such operations, the undertaker not being entitled to any compensation.

Section 3. The undertaker is absolutely master of his prices, though with the reservation that the maximum prices fixed by the city may not be exceeded, and at . . . kreutzers per carcel-hour, or . . . kreutzers for current furnished to a subscriber, equivalent to 1 horse-power hourly.

The electricity supplied may be calculated either in watt-hours or in ampère-hours, at the wish of the subscriber. In the opposite case (*i.e.*, if the subscriber does not express any choice), according to the maximum tariff for . . . watt-hours.

The undertaker is bound to submit the draft of his subscription certificates to the authorities for their sanction, and in these the intensities of the light are to be simply expressed in carcels. In every such document the following clause must be inserted.

" This certificate is invalid if the undertaker is not in a position to supply electricity within two months, if a second undertaker, prepared to supply electricity, lays down leads in the street inhabited by the party signing the document."

The certificates, the conditions, and any documents or agreements whatever entered into between the subscribers and undertakers, must be drawn up in triplicate, one of which, signed by the undertaker and the subscriber, is to be handed over to the municipal authorities.

Every undertaker is bound, at the request of the metropolitan authorities, to arrange public electric lighting in those streets which his leads traverse.

If the undertaker does not construct a conceded line of conductors within a year, reckoned from the day of concession, such concession becomes null and void.

The authorities can reduce the prices agreed on after the lapse of five years, if the profits of the undertaking increase in consequence of a new method of obtaining current.

Every subscriber is entitled to such reduced price without reference to any conditions agreed on in his certificate.

The reduction of prices will be carried out by a commission of four members, two of whom will be nominated by the municipal general assembly, and two by the undertaker. These persons select a fifth member as president, and if they cannot agree on the person to be appointed, a president will be nominated by the president of the municipal building committee.

The decision of the commission becomes valid only after it has been accepted by the general assembly.

If the undertaker does not select two experts within eight days after being so required, they may be nominated by the president of the municipal building commission.

Each reduction of price ceded by the undertaker to the subscribers will be valid for the entire term of the concession, and the scale of prices cannot be raised again.

Section 15. The undertaker is bound to provide at his own cost the appliances required for photometric determinations, and for all enquiries deemed requisite and carried out by the authorities.

Section 16. The undertaker is bound to pay the following dues half-yearly:

1. For every kilometre of the length of the conduction 10 florins yearly, or 1 kreutzer per metre.

2. . . . . per cent. of the receipts as determined from the subscribers' certificates, or from the readings of the electricity meters, both as regards electricity for light and for the transfer of power.

To this end the undertaker is bound to submit to the metropolitan authorities the evidences of his income in the month preceding the half-yearly audit.

No deduction will be allowed for outstanding claims.

Section 17. If the current is generated outside the municipal boundaries, the gross receipts will be raised by 1 per cent.

Section 18. The undertaker is bound to make the above payments half-yearly, not later than eight days after receiving the official demand. He is also bound to place at the disposal of the municipal delegates the data required as under Section 18, especially the requisite account books and certificates of payments.

Section 19. The expenses of the control to be carried out on behalf of the city is to borne by the undertaker.

The sums due for any year are to be paid in January in the year following within eight days after receiving notice.

Section 20. The undertaker forfeits his concession:—

1. If he openly or secretly conveys to a third person or to other undertakers, wholly or in part, the rights secured to him by the present conditions without having previously obtained in writing the special consent of the authorities.

2. If he does not commence working within . . . . days counting from the grant of the concession, and if he is not in a position within . . . . and within the conductive net agreed on to meet the demands for a supply of electricity as previously determined.

3. If the undertaker does not extend the leads of the original net on conditions enumerated as soon as the yearly demand per decametre of conduction attains 750 watts for 750 hours.

4. If he interrupts the supply of electricity within the term of the concession in the entire net or in a part of the same without the previous consent of the authorities.

5. If the undertaker does not comply with the demands laid down in the above conditions.

6. If the undertaker does not meet his payments or becomes insolvent.

7. If the undertaker becomes insolvent whilst laying down the cables, the city is at liberty at once to restore the public streets to their former condition.

Section 21. The metropolis reserves to itself the right to redeem the conductions within a certain time, reckoned from the commencement of the term of the concession.

. . . . . .

In case of such redemption, the right of redemption of the city comes into force as regards the leads, machines, &c., apparatus whatsoever, the fittings of the workshops, the furniture of the offices, the plots of land and buildings, and all the appliances required for working the undertaking.

. . . . . .

The price of redemption will be paid to the undertaker within half a year after the redemption has been concluded, and in consequence of this redemption the city enters into possession of all rights, privileges and conditions of the undertakers. In no case, however, and under no conditions, can the metropolis be drawn into any dispute or litigation between the undertaker and third persons.

As concerns this reservation, the undertaker is barred from selling or mortgaging, for the benefit of any person, immovable property which forms an asset of the undertaking, whether in the public streets or in land forming the property of private persons.

From these conditions are excepted immovables forming the property of the undertaker, but not necessary for the operations which are the object of the concession.

Section 22.—On the expiry of this agreement, the leads pass free of cost into the possession of the city, in as far as their removal is not considered necessary.

In the latter case, the conditions existing before laying down the cables, &c., in all public places, must be restored at the cost of the undertaker, without any compensation.

The metropolis is also entitled to acquire all immovable property upon which there exists any plant used by the undertaking, and serving for the production of electricity, with all buildings, apparatus, and appliances which subserve the purposes of the electrical installation, or are necessary thereto. If no agreement has been made for their redemption, the city may acquire them at a price to be judicially determined.

The city is, however, bound to make its intention known to the undertaking at least two years before the expiration of the concession.

The immovable property is to be handed over by the undertaker free from all liabilities and debts.

The patents used by the company are to be left open to the use of the city. This condition holds good for the case of the withdrawal of the concession either as regards the entire net or single portions thereof.

Section 23.—The undertaker is solely responsible as well to the city as to other parties for all damage which may result in consequence of laying down the conductive net and working the installation.

The undertaker disclaims the right of taking any proceedings against the city on account of injuries which may result in consequence of accidents during the operation in the public streets, or from any other causes. As against third persons, the right of the undertaker to compensation for damage remains in force; but in this respect the city gives no guarantee.

Section 24. As guarantee for the above-named obligations, the undertaker has, on the signature of the agreement, to pay into the municipal treasury . . . , either in cash or in securities of admitted value.

If the conductive net is longer than 1,000 metres, this guarantee fund is to be increased by 1,000 florins for every additional 500 metres.

This guarantee fund is forfeited to the city if the undertaker fails to observe the points 2 and 3 of Section 20.

Section 25. The materials for building and construction must be of native manufacture, and if foreign materials are used, official permission must first be obtained.

Section 26. All taxes, stamps and printing expenses incurred in consequence of this agreement must be defrayed by the undertaker.

A MODIFIED FORM OF WHEATSTONE'S BRIDGE.

IN comparing the resistances of two nearly equal coils a fine adjustment may be obtained either by a divided wire of low resistance in series with the coils, or by a resistance box in

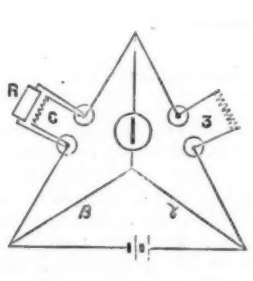


FIG. 1.

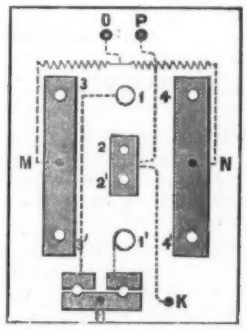


FIG. 2.

parallel with them. Mr. R. A. Lehfeldt states that the latter method, involving only a piece of apparatus that exists in every laboratory, appears to be somewhat simpler than the

D

more common one, for which a specially mounted wire is required, and it avoids therefore the disadvantage of a sliding contact.

In the *Philosophical Magazine* for July 1st, Mr. Lehfeldt gives some mathematical details as to the use of this modified bridge.

Referring to the figure, β and γ are two nearly equal resistances permanently mounted.

Let b and c be the coils to be compared, R a resistance box in parallel with the higher of the two; b_1, c_1 the resistances of the connections of b and c.

Put $$\frac{c\,R}{c+R} = c'$$

then $$(c' + c_1)\,\gamma = (b + b_1)\,\beta$$

If c and R be interchanged with b, and R has to be altered to R′ for balance, putting

$$\frac{c\,R'}{c+R'} = c''$$

then $$(c'' + b_1)\,\beta = (b + c_1)\,\gamma$$

Hence $$b = \tfrac{1}{2}\left(\frac{c'\gamma}{\beta} + \frac{c''\beta}{\gamma}\right) + \frac{(b_1\beta - c_1\gamma)(\beta - \gamma)}{2\beta\gamma}$$

The second term may be neglected.

$$\therefore\quad b = \tfrac{1}{2}\left(\frac{c'\gamma}{\beta} + \frac{c''\beta}{\gamma}\right)$$

put $\gamma = \beta(1 + \delta)$, where δ is small.

Hence,

$$b = c'(1 + \delta) + c''(1 - \delta)$$
$$= \frac{c' + c''}{2} + \frac{\delta}{2}(c' - c'')$$

Here, again, the second term may be neglected.

Hence,

$$b = \frac{c' + c''}{2}$$

That is, the resistance of b is the mean of the two values of c and its shunt obtained by reversing.

Mr. Lehfeldt has designed the form of switchboard, as shown in fig. 2, for this method.

The shaded parts are solid brass or copper.

The dark circles are binding screws.

The light circles are mercury cups.

The coils to be compared are put between 1 and 2 and 1′ and 2″. The terminals of the resistance-box are connected to H, K, so that by inserting a plug it can be put in parallel with either of the coils. 1 and 1′ are then connected by copper bars either to 3 and 4′ or 4 and 3′. The nearly equal resistances, β and γ, are wound on the same reel, and may be soldered permanently in place. M, N, are the battery terminals; O, P, those of the galvanometer.

From the original equations by deducing the equation

$$\delta = \frac{c'' - c'}{2\,b}$$

the ratio δ of the nearly equal arms β and γ may be tested.

If the coils to be compared differ as much as a B.A. unit does from a legal ohm, the resistances taken from the box will give the difference to 0·0002 ohm, and interpolation by means of the galvanometer deflections need only be resorted to beyond that.

EXECUTIONS BY ELECTRICITY.

IN the REVIEW for August 8th, 1890, we penned a leading article on the execution by means of electricity of the murderer Kemmler, and we concluded with an extract from a previous number, which it will not be out of place to reproduce again. It reads as follows:—"Notwithstanding the impression which the bungling over Kemmler must have produced in the public mind, we do not think there is any need to modify anything we then said. We confessed that at first we were reluctant to entertain the idea of electrical means being adopted for the purpose. But this was mere sentimentality—selfish sentimentality; and when we came to reason calmly, we could not perceive that we had more cause to object or complain than would the hydraulic engineer if death by drowning were proposed, or the cutlers of Sheffield, if the guillotine were to be brought into use in this country. The trend of civilisation, moreover, being towards lessening rather than increasing the horrors of capital punishment, it behoved us to consider whether death by electricity could not be made immediate and sure, for the rope has not been infallible. We thought so, and again we assert our belief that in proper hands there need be no hitch and no fear of failure with the electric current."

Judging from the news received this week from America announcing the fate of four more criminals, it appears that our comments have been entirely justified by the results.

The murderers executed in Sing Sing Prison on Tuesday morning were: James Slocum, a baseball player, who killed his wife; Levy Smiler, a lieutenant in the Salvation Army, who killed his third wife; Joseph Wood, a negro, who killed another negro in a quarrel; and Jugiro, a Japanese seaman, who killed one of his own countrymen.

The witnesses to the proceedings were sworn to secrecy as to the details; but several of them have declared that the process was successful and satisfactory. Most of the witnesses were physicians and electricians.

The electricity was applied to the head and the calves of the legs, the same as in Kemmler's case at Auburn last year. The men were seated in a chair with a foot-rest and an inclined back. The dynamos had been tested up to 3,000 volts, and the previous day were applied to a horse, which died instantly. In the case of Kemmler, it was estimated that the strength was only 750 volts; the force of the current on Tuesday was between 1,500 and 2,000 volts.

All newspaper representatives were excluded from the scene.

Dr. Rockwell, who was one of the commissioners appointed to supervise the execution, made the following statement:—

"Everything passed off in the quietest, most expeditious, and admirable manner. Each man was strapped into the chair with the least possible delay, and without the slightest bungling. The electrodes were applied, the current turned on, and the man was dead. There was no struggling, no fainting, no sickening details of any kind. At the instant the electric current entered the body there was one sharp, convulsive movement, lasting not more than a quarter of a second; then the subject was perfectly quiet. Death was instantaneous. The success of execution by electricity is assured beyond a doubt. I look now to see the barbarous practice of hanging condemned criminals entirely abolished in the United States before three years have passed."

Shortly after Kemmler's execution the *Scientific American*, which of all the transatlantic papers then to hand seemed to to have taken the fairest and most impartial view of the incident, stated that the apparatus employed was sure and effective, and that the criminal was instantly killed. Our contemporary then went on to argue as follows:—"The most intelligent of the witnesses, disinterested persons, also the warden of the prison, declare that as a mode of execution the electrical plan is far preferable to the scaffold. It is rumoured the Westinghouse Company or some of its adherents spent many thousands of dollars in fruitless efforts to nullify and obstruct the operation of the new law. The ablest lawyers and experts, who ordinarily receive large fees, were employed. The execution of a criminal, whether by the guillotine, the garotte, the gallows, the gun, or the dynamo, is a ghastly business; and it is not surprising that the sensational newspapers, aided by the electrical opponents of the law, should have made the most of such an occasion to fill their columns with revolting details."

We are sorry to see that there are still evidences of party feeling pervading the latest phase of electrocution, for although Drs. Rockwell, Southwick, Macdonald, Wilson, and others declare that only one shock, causing instantaneous death, was administered to each criminal, and express their satisfaction at the manner in which the execution was carried out, Dr. Daniels, on the other hand, says he might tell a great deal were he at liberty to do so. In each case, he declares, the Kemmler scene was repeated. Each man got two shocks. This, he added, would make a startling story; but no further particulars could be got out of him.

A telegram dated July 7th, New York, reads to the following effect:—"An eye-witness has supplied the following particulars of the executions:—'As soon as the operator shifted the lever, the body in the chair stiffened against the

straps, and became perfectly rigid. All the muscles were firmly set, as though in some awful effort to escape from the bands by which they were restrained. The straps strained with the sound peculiar to stretching leather, and their edges pressed deep into the yielding flesh of the face, and gripped the clothing tightly. The expression of the face was concealed under the broad bands that were drawn across the eyes, nose and chin. The skin exposed to view turned purple and red. Dr. Macdonald's eyes were fixed upon the stop-watch which he held in his hand, and when it marked 20 seconds, he nodded to the electrician, who stood by waiting for the signal with his hands on the switch. It had been decided to wait for the executioner's response to the signal. In order to make sure of a fatal result, a second shock was applied. The skin and flesh of the leg, and almost immediately afterwards that of the forehead, began to smoke. Dr. Macdonald again signalled to the electrician to turn the switch, the current was withdrawn, and immediately the body collapsed in such a manner that no doubt could be entertained that Slocum was dead. In Smiler's case a current, registered at 1,500 volts, lasted 20 seconds. It was then turned off, and the chest of the man in the chair began to heave. The current was turned on again, until, as in Slocum's case, it burned the flesh. It was then shut off, and the body removed to the adjoining room. Wood and Jugiro underwent the same ordeal with substantially the same results."

However, whatever arguments may be advanced by the opponents of execution by electricity, there seems to be no reasonable doubt but that the method is swift, sure, and free from suffering, for upon the autopsies on the bodies of the four men being concluded, Dr. Macdonald stated that in each case unconsciousness instantly supervened upon the application of the electric current, and that death was painless. He adds that only one shock was necessary in each case, and that there was no burning of the flesh, and in this Drs. Wilson and Southwick concur.

At the time of Kemmler's fate we expressed the belief that a continuance of the law which made death by electricity legal would have a salutary effect upon the criminal classes in New York State, and that other States might do worse than adopt it. We now see no reason to modify any of our former remarks.

THE TRAMWAYS INSTITUTE.

THE annual meeting of the Tramways Institute of Great Britain and Ireland was held on Thursday of last week at the Westminster Palace Hotel, under the presidency of Mr. W. J. Carruthers-Wain. As compared with the assembly in the previous year, the proceedings on the 2nd inst. were remarkable from the facts that the subject of electricity as the motive power on tramways occupied the attention of the institute for about four hours, and that the interest of the representatives of the tramway companies in the United Kingdom has now been fully manifested in the desirability of introducing modern methods of traction if the latter can be rendered commercially remunerative.

During the course of the formal business of the meeting the chairman referred to the Bill of the Birmingham Central Tramways Company, authorising them to employ electric traction, as reported in our "Parliamentary Notes." In the chairman's opinion that was one important reason why tramway companies should be united among themselves.

THE LINEFF SYSTEM.

The first paper read was by Mr. Gisbert Kapp on the "Lineff System of Electric Traction," which has already been described in previous issues of the REVIEW. The first portion of the paper was devoted to a consideration of different methods. Mr. Kapp referred to the advantages of a closed conduit and compared it with the slotted rails at Budapest, where an underground conductor system prevails. The author maintained that such an underground open conduit system is rather expensive and was objected to by the general public and by tramway men; Lineff's system therefore offered advantages, both in cost and convenience, over the older rival. Overhead conductors cannot be tolerated here, and storage battery cars were almost twice as heavy, therefore the power necessary to propel the vehicles is in the proportion of 11·5 to 6·5, the larger figure representing the energy requisite for the battery car, the smaller for a car deriving its current from a metallic conductor. This did not only affect the coal bill, but also the depreciation and interest upon the larger plant requisite. Mr. Kapp stated, among other things, that the weight of a full sized storage car in service was 11 tons, and that of a car which derived its power from a conductor laid along the line 8 tons. The average electrical horse-power required during the time the car was in operation might be taken as 7½ H.P. and 5½ H.P. respectively; the average loss in the conductor was 5 and 20 per cent., and in the batteries from 30 to 40 per cent. Thus the power which had to be generated at the depôt calculated over the whole time the cars were in service was 11½ H.P., and 6½ electrical H.P. respectively, or say 15 I.H.P. and 8½ I.H.P. per car. Mr. Lineff estimated the cost per mile of double track at £2,500. The speaker had found that the loss in collecting the current was 9 per cent., leaving 91 per cent. for propulsion. About a year ago he made insulation tests on the Chiswick line, and found that the average insulation resistance per mile was 4,475 ohms. This figure was unsatisfactory, and he urged upon Mr. Lineff the necessity of improving the insulation. The latter gentleman had since then devised an arrangement which was shown by means of a model. In this new arrangement of conduit, the conductor consisted of a copper trough supported at intervals by earthenware insulators instead of, as was the case formerly, its touching the bottom of the channel along its whole length. By that means the area of the surface along which a leakage of current could take place had been greatly reduced and the insulation very much increased, the principle being similar to the arrangement in certain parts of London of the electric light mains. From figures of tests supplied to him by Mr. Lineff, the speaker found with the new arrangement of conductor that the insulation averaged 35,000 ohms, and he had no doubt that it might be increased to 100,000 ohms by blowing cold air into the channels in the manner adopted by Prof. Robinson for the electric light mains in connection with the station of the St. Pancras Vestry. The new method had also the advantage that the iron strip could be withdrawn for renewal or cleaning without disturbing the surface of the street, this being accomplished by the arrangement of draw-boxes at certain intervals.

In opening the discussion,

Mr. STURGEON, of Chester, stated that he was of opinion that when it was desired to stop or reduce the speed of the car, the inserting of resistance into the circuit would cause a great loss of power. It seemed to him that as the motive power was electricity, and no solid coupling was used, there was considerable danger of the conductor being dropped, and of the power being lost at a critical moment.

Mr. A. DICKINSON, of the South Staffordshire Tramways Company, of Darlaston, had just returned from the United States, where he had investigated the various methods of electric traction there employed. He thought that it would be quite as impossible to prevent damp and wet from getting to the Lineff conductor as in any ordinary system. If water, in sufficient quantities, were to find its way into the conduit, so as to form a conducting medium to the earth, there would be an enormous loss of current. In Boston, a conduit from 2 feet to 3 feet deep had been used, and dirt and water could not be kept out. The moisture ascended the sides of the conduit, and forming contact with the earth, there was a great loss of current, the ultimate result being that the system had to be abandoned. That being the case with a 3 feet conduit, how was water to be prevented from entering the Lineff conduit? With reference to the sectional rail, how was the road dirt to be kept off it and the current collected? Even with the overhead system in America, the loss of current was considerable, and it had been found necessary to doubly insulate the feeders and trolley wires by insulating the insulators. He concluded that if such leakages could not be hindered in the United States, where there was only the moisture, it would not be possible to do so with the Lineff system, where water might collect at the bottom of the conduit.

Mr. A. RECKENZAUN rose next and assured the meeting that he had not come to advocate any particular system of traction, but he felt the greatest interest in the subject from every point of view, and he had studied and practically worked on this question for upwards of nine years. He was very much interested in Mr. Kapp's paper, but he was bound to take exception to several of his statements. With regard to the insulation measurements of Mr. Lineff it appeared to him somewhat premature to give the values per mile, considering that the tests made were on an experimental track some 70 yards long, and in the condition of a laboratory experiment. The possibility of leakage increases with the length of the line, especially in this case where sections of conducting rails are periodically in actual contact with the roadway, which, after a soaking rain, must be a good conductor. Moreover, the minutest cracks in the conduit, which are likely to result through abnormally heavy road traffic, will readily establish sources of leakage between the inner conductor and the earth surrounding the channel. Mr. Kapp had referred to the objection against slotted conduits, and he had also mentioned the Budapest electric tramway. At Budapest the conduit was immediately underneath one of the tramrails, which must have slots for the wheel flanges to run in, there is therefore no additional opening in the road. What tramway men want nowadays were figures relating to the working costs of propelling cars by electricity, and he (Mr. Reckenzaun) had brought such concerning two important continental lines. The combined length of the electric tramlines at Budapest is 16 kilometres; it has been in operation for about 18 months. The popularity of the electric system is shown by the large number of passengers carried per kilometre. In the month of April, 1890, the number of passengers per kilometre was 2,590, and this increased in December of the same year to 3,621. The horse tramways of the same city, however, carried 2,730 and 2,267 passengers during the corresponding months, showing a material falling off. The maximum speed allowed by the municipality is 11 miles per hour. The expenses of the electric tramway amounted to only 45·4 per cent. of the gross revenue, whilst with the horse tramways of the same city, the ratio between expenditure and income was 71·8 per cent., which corresponds with the best English tramways. Referring to the cost of construction and equipment of Austrian lines, it was shown that the horse tramways of Vienna have cost £4,100 per kilometre; the steam tramways of this city, £7,000; and the electric tramway of Budapest £3,000 per kilometre, of which £1,400 was expended on the conduits and conductors. The electric traction expenses, inclusive of all

charges were during the year 1890, 2·8 pence per car kilometre. The other line which was in his mind was that of Frankfort, which has been in operation for about seven years. In this case also comparisons can be made between horse traction and electric traction. The Frankfort electric tramway is worked with overhead conductors, and it has been built by the same firm as the Budapest line—Messrs. Siemens and Halske. Last year the electric cars made 519,770 car kilometres at a cost of 2·73 pence per kilometre; whereas the traction expenses on the horse car lines of Frankfort were 5·04 pence per car kilometre, showing a saving of 46 per cent. But in the case of the electric line two cars were always coupled together, carrying only one driver and one conductor, whereas the horse cars had each a driver and a conductor, consequently the comparison is not quite fair. On the other hand, the horse tramway has a very much greater traffic. It can easily be shown that if the electric tramway were worked on the same scale as the horse tramway, and each car had its own motive power and attendants, the saving would amount to at least 40 per cent. In conclusion, Mr. Reckenzaun wished to point out another error in Mr. Kapp's paper, and that related to a comparison between the power required to propel a storage battery car and an electric car connected with overhead or underground conductor. It has been repeatedly found, in practice, that the energy necessary at the central station is practically the same for all cases under similar conditions. It is perfectly true that the storage battery car has from 1½ to 2 tons more weight to carry, and that the working efficiency of the cells is not much more than 70 per cent. But the plant at the central station with conductor system must be large enough to respond at any moment to the greatest demand for current, and this is often three to four times as great as the average working rate. The fluctuations in power are enormous; within the space of a few seconds it may vary between zero and the utmost energy the engine may be capable of exerting; this is a serious disadvantage with the conductor systems and entails a waste which is infinitely greater than that usually accounted for as "loss on the line," &c. Storage batteries, on the other hand, are charged with a constant current; the engine and dynamo run all day at their best efficiency with a steady load, and the fluctuations occur only in the car, where the cells give out any energy demanded by the exigencies of road and load. The losses due to the conversion of energy in the batteries and the extra weight are fully compensated by the steady working at a uniform rate of the charging plant.

Mr. W. J. CARRUTHERS-WAIN, of the Birmingham Central Tramways Company, &c., found on a recent visit to the United States that electricity for traction purposes was an advantage both to the public and the tramway companies. Many of the tramway companies were converting their lines into electric roads. Respecting the Lineff system, he desired to know the cost of the generating plant generally, of the cars, and the estimated cost of working per mile, and whether the £2,500 stated as the cost of laying down the system referred to a new line or the conversion of a horse tramway into an electric line. Turning to the Birmingham accumulator cars, he said that he was unable to give the actual cost of working owing to the financial year having only just terminated. He was, however, in a position to state general results of the operation of the line during the past three years, as follows:—

Year.	System.	Miles run	Total receipts.	Receipts per car mile.
1889	Horse cars	134,000	£6,338	11·30d.
1890	Horse cars and omnibuses	136,000	£5,264	9·29d.
1891	Electric cars	148,000	£8,949	14·46d.

These figures were very favourable to electric traction. He was glad to hear from Mr. Reckenzaun that in some cases of electric traction the expenses amounted to only 45 per cent. of the revenue; it would be a fortunate thing for British tramway shareholders if such a condition of affairs could be evolved this side of the Channel. He was agreably impressed with what he saw in the United States during his protracted travels last year, and he found that the electric roads over there were doing well, many paid substantial dividends, and he was sure they will do even better in future. The relative figures obtained by the Washington Census Bureau on various methods of traction came out as follows:—Cable, 6·77 pence per mile; electricity, 6·34, and animals 8·75 pence per car mile.

In reply to Mr. CARRUTHERS-WAIN,

Mr. KAPP stated that with modern steam dynamos the total cost of the generating plant at the depôt would amount to about £25 per electrical H.P. required, or about £200 for machinery per car. A gradient of 1 in 20 was the highest he would care to design a car to mount. In answer to Mr. Sturgeon, he said that an electric motor would work economically at a wide range of load, and that there was no motor so elastic in its application as an electric motor. Mr. Dickinson had referred to the double insulation of overhead wires. With the Lineff system, however, it was not proposed to place the conductor out in the rain. When the road was dirty, sparking would ordinarily take place, but by the addition of brushes the difficulty had been overcome. A scraper was carried at the head of the car, in order to remove obstacles, and in muddy or wet weather the collection of current was best effected. With reference to the cracking mentioned by Mr. Reckenzaun, he had taken a steam roller over the Chiswick without any injurious effect.

THE JARMAN SYSTEM.

Mr. A. J. JARMAN then read a paper on "Self-contained Electrical Tramcars." This referred in detail to the Jarman system, which was described in this journal some time ago. In speaking of storage batteries, he said that one serious objection had been overcome, namely, the burning asunder of the lugs and bridges, which involved frequent repairs, and consequently militated against the regular working of the cars. The cause of this defect was not at all times due to the flow of a heavy current, but to the cracking and crystallising of the leaden lugs and bridges. He had overcome this difficulty by inserting a solid ¼-inch tinned copper conductor in the centre of the lug and bridge, and duplicating the connections throughout, thus making a combined lug and bridge that would carry 450 ampères safely, and at the same time reduced the internal resistance of the cell to one-half, the tendency being when the fly nuts were tightened to improve the connection rather than to injure it. The fly nuts of the improved cells he had devised were made of aluminium, and weighed only 100 grains when finished, the double connected lug being always used when the plates of the cell were vertical. An example of improvements made in storage batteries for traction purposes was shown by one of the cells exhibited at the meeting, and in which the alloying of aluminium with lead in the plates stiffened the plate and increased the capacity of the negative plate to absorb and retain hydrogen. The composition of the material which eventually became active was such that it contracted so much in the drying that it was impossible to use it to paste a plate, but it swelled or expanded to a certain extent during the process of forming, so that it made perfect contact with the metallic part of the plates, and when the plates were formed they had quite a metallic ring in them when tapped with the hand. The form and construction of the battery plates was such that the material which eventually became active was so keyed in that it could not, and did not, fall out when the battery was in action. The author had not found these plates to buckle at any time, even when discharging up to 300 ampères. Where the plates were arranged horizontally, if any material should by any means fall from one plate on to the next, then that material became a part of the lower plate during the process of charging, and should any powdery material fall or get washed down the sides by the action of the liquid, then if the space at the bottom of the cell became filled so as to touch the plate, it simply increased the capacity of the bottom plate instead of short-circuiting the lot, which had often happened with the cells which had been in use during the past five years. As regarded the durability of the storage battery, he had reason to believe that the number of discharges those cells would bear would be at least half as many again as borne by those now in use, if not double the number, before any renewal of positive plates was required. The author estimated the consumption of fuel, wear and tear of machinery, and renewal of batteries, would amount to about 2d. per car-mile.

Mr. W. MASON, of Bradford, was of opinion that storage battery cars only would succeed in this country. The main considerations were what would be the cost of putting a line of cars into service, and would they be remunerative. He desired something more economical than horse haulage, and they would all be glad to substitute electricity, if that agency would pay as a motive power.

Mr. W. TURTON, of Leeds, said that his company had adopted steam years ago, which costs between 4d. and 5d. per mile. If they saw a system as cheap as steam, they could not adopt it because of the large capital to be again invested. They could not throw away their plant. Any new system of traction on an existing line would have to be charged with the new capital to be invested plus the capital already sunk, and that was a difficult thing. The shareholders expected dividends which must be earned not by increasing the capital charge, but by increased economy, and advocates of improved systems of traction must bear this in mind when they calculate the probable economy of the changed conditions.

Mr. ARCHER said it was simply a question of "What can you do it at?" He advocated storage batteries if a good battery can be got, one which would last and be economical. The overhead wires in America gave a good deal of trouble; they interfered with the telegraphs and the telephones.

Mr. JARMAN was sure that he had a good motor, and he hoped that his battery will be lasting.

The last paper on electric traction was read by Mr. J. GORDON, who described his closed conduit system, which has been experimented with at the works of Messrs. Merryweather and Sons, of Greenwich, for several months with, it is said, satisfactory results. The general principle of the system is a series of contacts charged by means of automatic magnets in a box placed in the ground at intervals of 90 yards, or about 20 per mile of track. A shoe carried by the car slides upon the third rail, and the current is collected as the car proceeds, the section under the car only being charged with current.

Mr. SCOTT-RUSSELL knew the difficulties which cropped up in practice, and most practical men were aware of it. He quite agreed that the accumulator system was the only possible system in this country, but most of the experiments had been disastrous to the promoters. The Brussels experiments had been given up. On a certain line in London accumulator traction is said to cost 9d. per car mile; and at Birmingham a similar system costs 10d. per mile. Unless Mr. Jarman demonstrates practically that with his system he can work at less than half these figures, it is useless to look at it. The lead accumulator has got as far as it ever can get.

Mr. HOLROYD SMITH told the meeting that Mr. Gordon described a system which he (Smith) invented long ago, in fact Mr. Gordon copied almost his own words in the paper. Mr. Smith asked the council of the Tramways Institute to formulate exactly those items which are to be included in the traction expenses; it was an unsettled question. He did not claim to be a scientist, but rather a practical man, and he would guarantee that electric traction with his system was cheaper than cable, horses or compressed air, and he offered to equip any line, and run it at his own cost, until it suits the tramway company to take it over, and he requires no other compensation but the amount of money hitherto paid on the given line for horse traction.

Mr. STURGEON created much mirth by exclaiming that since the advocates of electric traction are condemning each other there is nothing left but the compressed air system, and he subsequently read a paper entitled "Compressed Air Motor" (Hughes and Lancaster system).

Mr. A. NETTER read a paper on the Connelly motor, which is a petroleum engine, and he offered to run tramcars with this motor for half the cost of any existing electric system. Compressed air, Mr. Netter said, was nowhere, and no invention of any age has had the puffing which the electric motor had, and in his opinion the success of electric traction is extremely doubtful. These statements were received with loud laughter.

The CHAIRMAN closed the discussion of the last electrical paper by saying that the members of the Tramway Institute were eminently practical men. What they wanted is not experiments, or occasional runs with one car, but the working results of a fair ordinary condition of service. It is not our business to find out the best system, but we would take it over when it is ready for every-day use. There are a number of lines in this country where we should welcome the advent of any perfected system. With regard to traction with accumulators, there is, behind the scenes, more than the public are aware of. The Brussels system has not been an entire failure; it was opposed by parties in the company. The Barking Road line was a small affair, too small to form a broad judgment of its real value; people tell me that they are satisfied with it. As regards the Birmingham battery cars, although he is chairman of the company owning these cars, he had not got the actual figures yet, and he would ask Mr. Scott-Russell where he obtained the figures as to the working expenses. Whatever the financial success may be, it has already been demonstrated that the revenue has been increased 50 per cent. by means of the electric cars. But we hope that the working expenses will turn out in favour of the novel method. We had several difficulties to contend with at Birmingham which had nothing to do with the electrical part. The rails were one inch and more out of gauge, and gentlemen in this room will know what this means, what energy there must be wasted in grinding through steel rails.

In the course of his reply, Mr. JARMAN stated that he was prepared to stand or fall by his cars.

LONDON COUNTY COUNCIL.

IN the Parliamentary Committee's report is the following paragraphs:

ELECTRIC LIGHTING PROVISIONAL ORDER (No. 10) BILL.

The Council on the 2nd instant referred it to us to take any steps which might be necessary on behalf of the Council with reference to this Bill amongst other electric lighting bills. The Bill contains a clause authorising the transfer to a single company of the undertaking of the two companies authorised to supply in the City of London, and also the undertaking proposed to be authorised in the district of St. Saviour, Southwark, in which the station for generating electricity to be supplied to the City of London will be situate. It is obvious that on any such transfer some complication may arise by reason of the fact that the County Council have the appointment of Inspectors generally in the County of London, and the Corporation have the appointment within the City. Moreover, the enactments in the orders within the City do not in some respects correspond with those in force outside. A difficulty also would arise in connection with the question of purchase. As the time for lodging the petition expired on the day of our meeting, we sanctioned the presentation of a petition, which has accordingly been done. The attention of the Board of Trade has already been directed to this clause in their orders, but that Board think the clause should be retained, and have retained it, so that if the petition is proceeded with it becomes rather a question of opposition to the Board of Trade by the Council. The clause in question provides that any transfer under the terms of it shall be on such terms and conditions as the Board of Trade impose, and we understand that the Board of Trade think that this would be sufficient to enable them to deal with any question which might arise. We have requested the deputy-chairman and the chairman of the Highways Committee to seek an interview on the subject with the proper official of the Board of Trade, and if satisfactory arrangements can be made, the petition may be withdrawn. In the meantime, we recommend that the course taken by us in presenting a petition against the Bill be approved.

NOTICES UNDER ELECTRIC LIGHTING ORDERS AND ACTS.

We have considered two notices from the Kensington and Knightsbridge Electric Lighting Company, one dated June 18th, 1891, of proposed extension of mains at Rutland Gate, and the other dated June 22nd, 1891, of similar works at Stanhope Gardens. The proposed works are unobjectionable, and we recommend that the sanction of the Council be given to the works referred to in the two notices, dated June 18th and June 22nd, 1891, respectively, of the Kensington and Knightsbridge Electric Lighting Company.

The Electricity Supply Corporation has given a notice, dated 22nd June, 1891, of intention to lay mains across the Strand from the Adelphi Theatre to and along Adam Street, John Street, Duke Street, Villiers Street, under the arch of Charing Cross railway bridge to Northumberland Avenue, in Whitehall, Whitehall Place, Charing Cross, across Spring Gardens, in Trafalgar Square (north and west sides), Pall Mall (north and south sides), Warwick Street, Cockspur Street, Duncannon Street, Adelaide Street, St. Martin's Lane, Cranbourne Street, Leicester Square, Whitcomb Street, Panton Street, Haymarket, Coventry Street and Princes Street. The proposed works are of the same character as those of this company previously approved by the Council; but as in some of the thoroughfares referred to in the notice the traffic is very great, we are of opinion that the company should be required to carry out the works, when commenced there, in the shortest time possible. We therefore recommend that the sanction of the Council be given to the works referred to in the notice, dated June 22nd, 1891, of the Electricity Supply Corporation, upon condition that the Company do give two days' notice to the Council's chief engineer before commencing the work in any of the thoroughfares specified in the notice; that the work in the Strand, Whitehall, Charing Cross, Pall Mall, Haymarket, and Coventry Street, when once commenced, shall be carried on continuously by day and by night, and with as little interruption to the traffic as possible; that the mains shall be laid under the footways wherever it is found practicable to do so; that the concrete floor of the road-boxes be made nine inches thick; that the York stone at the top be four inches thick; that the longitudinal girders in all the boxes be laid on three-inch stone templates the full thickness of the brickwork; and that the whole of the works shall be completed within the shortest time possible.

We have also considered a notice dated June 22nd, 1891, from the Westminster Electric Supply Corporation, of intention to lay mains in Buckingham Street, James Street (part of), Stafford Place, York Street, Broadway, Queen Anne's Gate, Whitehall (part of), Whitehall Yard (part of), Whitehall Gardens, Downing Street, Richmond Terrace, Parliament Street, Derby Street, Cannon Row, Bridge Street, Great and Little George Streets, Delahay Street, Charles Street, King Street, Broad Sanctuary (part of), Parker Street, Dartmouth Street and Row, Lewisham Street, Great and Little Queen Streets, Princes Court, Cartaret Street, Victoria Street (part of), Palace Street (part of), William Street, Catherine Street, and Stafford Place south (3 plans, Nos. 82, 83 and 92). The company states that the district referred to in the notice is included in the order granted to the company by the Board of Trade this year, which, however, has not yet received the Royal assent; and asks, that in order to save time, and to enable residents in the northern portion of the parishes of St. Margaret and St. John, Westminster, to be supplied with the electric light during the next winter, the Council will give consent to the works on the understanding that they shall not be commenced until after the confirming Bill shall have received the Royal assent. We are of opinion that as the Order has been granted by the Board of Trade, and is likely to be confirmed by Parliament, the Council may, subject to the understanding above mentioned, give consent to the works so that the company may make preparations for carrying them out. As, however, there is a very large amount of traffic in several of the streets referred to in the notice, we think that in this case also, the company should be required to expedite as much as possible the carrying out of the works in certain streets. We therefore recommend that the consent of the Council be given to the works referred to in the notice dated June 22nd, 1891, of the Westminster Electric Supply Corporation, upon condition that no part thereof shall be commenced until the Bill confirming the company's order of 1891 shall have become law; that the works in Whitehall, Parliament Street, Bridge Street and Victoria Street shall, when commenced, be carried on continuously by day and by night, and with as little interference with the traffic as possible; that the company do give two days' notice to the Council's chief engineer before commencing the work in any of the thoroughfares specified in the notice; that the mains shall be laid under the footways wherever it is found practicable to do so; and that the covers of the street boxes to be used shall consist of iron frames filled in with material to suit the paving.

A notice, dated June 30th, 1891, has been received from the London Electric Supply Corporation of intention to lay trunk mains, consisting of concentric copper tube, enclosed in an outer iron tube, the whole buried in pitch, from Cockspur Street and through St. James's Park to Buckingham Gate (two plans, T. M. 6/91). Most of these works affect St. James's Park, which is Crown property, and the Council has no jurisdiction there. There appears to be no objection to the laying of the proposed mains; and we recommend that the sanction of the Council be given to the laying of the trunk mains referred to in the notice, dated June 30th, 1891, of the London Electric Supply Corporation, so far as regards the streets and places under the jurisdiction of the Council, upon condition that the Company do give two days' notice to the Council's chief engineer before commencing the works; that the mains where laid under the footway shall be kept two feet below the underside of the paving, and where they cross the carriageways at the same depth below the concrete, or, if this be found to be impracticable, that the mains be protected from mechanical injury to the satisfaction of the Council's chief engineer.

We have also considered a notice, dated 2nd July, 1891, from the Metropolitan Electric Supply Company, of intention to lay mains in Lisle Street and Leicester Place, and across Cranbourne Street. The proposed works are of the same character as those of this company previously approved by the Council; and we recommend that the sanction of the Council be given to the works referred to in the notice of the Metropolitan Electric Supply Company, dated 2nd July, 1891, upon condition that the company do give two days' notice to the Council's chief engineer before commencing the works; that the mains be enclosed in iron pipes or efficient casing, and be laid under the footways wherever it is found practicable to do so; that as an additional precaution against accident through defective insulation of the mains, each of the street-boxes shall be provided with an inner as well as an outer cover, the two insulated from each other as far as practicable; and that the outer cover, which shall consist of an iron frame filled in with material to suit the paving, shall be efficiently connected to earth.

We have to report the receipt of the following notice, given in accordance with the decision of the Council to accept four days' (instead of one month's) notice, in respect of the laying of service lines from mains already laid: July 2nd, 1891, from the Electricity Supply Corporation—to No. 74, Strand.

NOTES.

Institution of Electrical Engineers.—The annual *conversazione* of the Institution of Electrical Engineers was held on Monday evening in the galleries of the Royal Institute Painters in Water Colours, Piccadilly. About 800 guests accepted the invitation of Prof. Crookes (the president) and Mrs. Crookes, and among them were most of the leading scientific men of the day. The band of the Coldstream Guards, under Mr. C. Thomas, played a selection of music, and a pleasant evening was spent in viewing the exhibition of the Society of Portrait Painters, now being held in the galleries. Amongst those who accepted the invitation were the following :—

Sir F. Abel, K.C.B., F.R.S.
Sir J. Douglass, F.R.S.
Prof. A. B. W. Kennedy, F.R.S.
J. W. Swan.
W. H. Preece, F.R.S.
R. V. Boyle, C.S.I.
Dr. J. H. Gladstone, F.R.S.
Sir W. Thomson, P.R.S.
Prof. Heaton, F.R.S.
Latimer Clark, F.R.S.
Earl Russell.
E. Macrory, Q.C.
Prof. J. Dewar, F.R.S.
Duke of Marlborough.
J. C. Lamb, C.M.G.
C. Hawksley, M.I.C.E.
Sir Edwin Arnold.
Sir F. Bramwell, Bart., F.R.S.
Prof. W. G. Adams, F.R.S.
Prof. S. P. Thompson, F.R.S.
Prof. J. Perry, F.R.S.
Sir David Salomons, Bart., M.A.
H. J. Chaney.
Dr. W. J. Russell, F.R.S.
Edward Woods, P.P. Inst. C.E.
Harrison Hayter, V.P. Inst. C.E.
Dr. W. H. Perkin, F.R.S.
C. E. Spagnoletti.
Prof. J. A. Fleming, M.A., D.Sc.
R. W. Wallace.
Sir B. Baker, K.C.M.G.
Dr. J. G. Symons, F.R.S.
Dr. E. Frankland, F.R.S.
Sir Philip Magnus.
Sir E. J. Reed, K.C.B., M.P.
Sir Henry Doulton.
Colonel Salmond, R.E.
Major-General Maitland, R.E.
Sir J. C. Browne, F.R.S.
Dr. Hugo Müller, F.R.S.
Prof. W. Ramsay, F.R.S.
G. G. Ward (New York).
W. J. Karner, E. L. Corthell } Chicago Exhibition, 1893.
Prof. D. E. Hughes, F.R.S.
Prof. W. E. Ayrton, F.R.S.
Alexander Siemens.
Prof. R. Meldola, F.R.S.
Dr. H. E. Armstrong, F.R.S.
Edward Graves.
Prof. W. Grylls Adams, F.R.S.
Percy Gye.
Gisbert Kapp, M.I.C.E.
The Hon. R. Parsons.
P. V. Luke, C.I.E.
E. Garcke.
W. C. Johnson.
Prof. H. Robinson, M.I.C.E.
Shelford Bidwell, F.R.S.
L. Loeffler.
Dr. A. Waller.
G. J. Symons, F.R.S.
Dr. John Rae.
Dr. Leonard T. Thorne.
Dr. W. Sumpner.
Dr. H. Borns.
R. P. Sellon.
F. H. Webb.
A. P. Trotter, B.A.
Desmond FitzGerald.
J. E. H. Gordon.
Prof. Walmisley.
James Wimshurst.
H. C. Forde.
S. Z. de Ferranti.
Alexander Bernstein.
A. Chambre.
Mr. Ganz.
Ludwig Mond, F.C.S.
Dr. Ernest Hart.
C. W. Vincent.
Sydney Morse.
Conrad W. Cooke.
Perry F. Nursey.
Dr. John Hopkinson, F.R.S.

Association of Incandescent Lamp Manufacturers.—A permanent organisation has been formed in New York under the above title to regulate matters connected with the trade and lamp litigation. At the last meeting it was agreed to give a uniform guarantee of the life of the lamps made by the respective firms belonging to the Association. It was resolved to fix 70 cents. as the price of lamps in small orders, scaling down to 50 cents. for extra large quantities; the average life to be warranted up to 600 hours when the purchaser takes a number of lamps, but for a single lamp the manufacturers draw the limit of guaranteed life at 100 hours. This resolution is to be confirmed at a later meeting, when a fuller attendance is anticipated. By that time, perhaps, the Edison, Sawyer and Man, and Thomson-Houston companies may have joined the Association.

Mr. Edison and Ohm's Law.—"For 20 years," said Mr. Edison in his evidence in the great American lamp case, "I have heard of Ohm's law. I do not understand it now, and I do not want to understand it." If the great wizard of Menlo Park has failed to grasp so comparatively simple a matter as Ohm's law in his long period of study, surely lesser mortals may be exonerated if they cannot discover much novelty set forth in the claims of the Edison lamp patent, or do not comprehend the meaning of the words high resistance filament. Mr. Edison's own experts refuse to give a definite answer to the question: What does the term high resistance filament convey, or what does it cover? These experts shuffle out of the dilemma by saying they were not retained or instructed on that point, but that generally every other make of lamp is an infringement of the Edison patents.

Ader's Flying Machine.—M. Ader has finished his flying machines, and claims to have succeeded in flying short distances.

Cricket.—National Telephone Company Limited (Nottingham *v.* Birmingham).—This match was played at Nottingham on Saturday, July 4th, the home team winning by 9 runs.

Electric Lighting of Carlow.—On the 25th of last month, the electric lighting of Carlow was successfully inaugurated. The plant was erected by Messrs. Gordon and Company. The current is conveyed from Milford, 5 miles off, at 2,500 volts pressure. The high-pressure current is transformed and distributed throughout the town by bare copper mains at a pressure of 50 volts. The plant is said to be ample for the provision of the electric light for the whole of the town, both for public and private lighting.

The Dissipated Lightning Rod Man.—Mr. N. D. C. Hodges, the promulgator of the new theory of protecting buildings from lightning by employing what he calls "dissipated conductors," claims that the case of Newbury Church, quoted by Mr. Hubbell in an article we reprinted in our last issue, instead of proving his theory to be fallacious, could not afford a better instance of the truth of his contention that no damage has ever ensued to a building on the same level as the dissipated conductor. But Mr. Hodges does not give his reasons for this assertion.

Leading-In Wires for Vacuous Globes.—An alloy of silicon with iron, nickel, cobalt, silver, or gold in certain proportions has been discovered by Mr. R. A. Fessenden, of Roseville, New Jersey, U.S.A., which he states has the same coefficient of expansion as glass. The inventor also declares that the wasting away of a carbon filament in an incandescent lamp proceeds from the air which creeps in between the platinum wire and the glass, the coefficient of expansion of platinum and glass being in the ratio of 19 to 17. Provided this alloy has other qualities equal to platinum, that is to say, has not a higher resistance than that metal, and has a reasonably high melting point, it will be possible to improve the manufacture of glow lamps by ensuring to them a longer life than at present. But it must be recollected that the deterioration and attenuation of a carbon filament is not always caused by the admission of air, but more often by the volatilisation of the carbon by the action of the electric current.

Brown's Rotary Engine.—The advantages claimed for "Brown's rotary expansive engine," which we describe on another page, over its predecessors of the rotary type are :—1. The *wear* of the internal moving parts is rendered as far as possible uniform by fitting strips, backed by small spiral springs, so adjusted that their pressure is inversely proportional to the distance travelled by the moving part. In this way the joints between the ends of the piston and the cylinder covers are kept tight as well as between the outside of piston and inner circumferential surface of cylinder, and between the valves and their seats. 2. The valves can be adjusted so as to "cut off" steam at any desired fraction of the piston's revolution and hence economise steam. 3. Perfect cushioning is effected between the rotating valves and the steam inlet doors to cylinder during the termination of the exhaust, and consequently a very much higher number of revolutions per minute can be attained without undue noise and vibration, as in former rotary engines of the same type. 4. The cylinder steam doors bear continuously steam tight on the piston. 5. It is the first time in which indicator diagrams have been taken from a rotary engine and their information acted upon. 6. The economy in steam is greater than in any recorded trials of any other rotary engine, and in fact the consumption of steam is not more than the published performances of Willans's best single cylinder non-condensing engine, with about the same steam pressure and highest recorded speeds. Mr. Brown's engine is to be thoroughly balanced, steam jacketed and compounded, when the results should come up to Willans's compound engine which are the best yet recorded for fast speed engines. We are under the impression, however, that clause 5 is not justified; perhaps some of our readers can set the doubt at rest.

Electric Light in South London.—At Newington Vestry, on Wednesday, a letter was read from the Camberwell and Islington Electric Supply Company, intimating that on or before December 21st next they should apply to the Board of Trade for powers to supply electric light for public and private purposes in the parish of Newington.

Charlesworth, Hall & Co.—We are informed that Messrs. John Rankine & Sons of Leadenhall Street, London, and Corporation Quay, North Shields, consulting electrical and marine engineers have been appointed Messrs. Charlesworth Hall & Co.'s agents for the Tyne, Wear and Tees shipbuilding centres.

The Royal Society, Edinburgh.—At an ordinary meeting of this society, held on Monday evening, among the communications laid before the society, through Prof. Tait, were "The Electric Resistance of Cobalt at High Temperature," and "The Thermo-electric Positions of Cobalt and Bismuth," both by Prof. Knott.

The Demagnetising of Watches.—It is stated that Mr. J. S. Matheson, Leith, who has given consideration to the matter, has patented a process which he claims is effective for the purpose in view, and that watches treated in accordance with it have been thoroughly demagnetised and made to keep time as well as before being affected.

The Tramways Institute of Great Britain and Ireland.—No one need be surprised at the fact that electric traction monopolised the major portion of the time at the annual meeting of this institute on the 2nd inst. The Tramways Institute is to be congratulated upon the possession of such a broad-minded and well-informed president as Mr. Carruthers-Wain. His recent travels through the United States have put him in the position of an unbiassed judge of the merits of electric traction, as well as upon every other kind of traction in vogue at the present time. Between the hours of 11.30 a.m. and 4.30 p.m., electricity pervaded the whole assembly, which consisted mostly of tramway directors and managers. Among invited electrical men were Mr. Gisbert Kapp, Mr. A. Reckenzaun, Mr. Jarman, Mr. Gordon, and Mr. Holroyd Smith.

Brighton Electric Lighting.—The works undertaken by the corporation in connection with the supply of the electric light to Brighton are approaching completion, and the development of the arrangements for giving the public the new illuminant will be awaited with the deepest interest. The generating station in North Road is practically completed, and a set of three mild steel Lancashire boilers has been fixed in position in the boiler house, ready for firing at any time. The chimney of the boiler house is regarded as the most substantial and handsome of its kind in Sussex. Space is reserved for another set of three similar boilers, to be erected as soon as required. In the engine room are four dynamos, giving an approximate output of about 165 kilowatts, coupled to four Willans's central-valve engines, all strongly and securely fixed on their foundations. Overhead, a travelling crane, capable of carrying six tons, is provided, to facilitate the lifting and moving the great weights of the parts constituting and associated with the dynamos. Space has been reserved for doubling the number of dynamos and the engines connected therewith. In the battery room the framework and stands to receive the storage batteries have been placed in position, and the work of electrically connecting the cells is being proceeded with. Accommodation for a considerable addition of batteries has been secured in this room, to enable the corporation to comply with future requirements. The service and supply mains in the streets comprised in the existing scheme have all been laid, with the exception of the branch passing along the Western Road to the western boundary of the borough. With good weather this will be completed in a fortnight, when the work, as a whole, will be sufficiently advanced to enable the necessary tests to be made, after which connections to the premises of private consumers, the Dome, the Pavilion, &c., can be effected, so that within a short period "the Queen of Watering Places" may hope to be in possession of a substantial, safe, and thorough installation.

Priestman's Oil Engine for Electric Lighting.—We are glad to learn that during the two years which have elapsed since Priestman's oil engine was put upon the market the progress made has been very satisfactory. A large number of orders have been received for engines varying in size from 1 to 25 actual H.P. for electric lighting, and to meet the growing demand for these engines the works have been largely extended, with a view to giving prompt deliveries.

Edinburgh Telegraphists' Salaries.—The following is the revised scheme in regard to rates and duties of the major division of telegraphs in Edinburgh, issued under the sanction of the Treasury—minimum and maximum respectively:—1 chief superintendent, £440—£500; 2 assistant ditto, £300—£390; 4 assistants, (first class), £250—£300; 12 assistants (second class), £200—£250; 16 clerks, £150—£190. The hours of duty for the supervising staff to be seven, and the clerical staff eight hours per day.

Ship Lighting.—On Monday afternoon Messrs. Ramage and Ferguson, Leith, launched a finely modelled composite yacht, built to the order of Count Stroganoff, Russia. The vessel, which is the largest yet built on the east of Scotland, is 980 tons Y.M., and was designed by Mr. W. C. Storey, London. She will be fitted in the most magnificent and luxurious fashion, and will have all the latest improvements, including an installation of the electric light, steam stearing gear, &c. The engines will be supplied by the builders, and will have cylinders of 20-inch, 30¼-inch, and 51-inch by 30-inch stroke, and will be capable of driving the vessel 12 knots an hour. She will be rigged as an auxiliary, having a full and ample supply of canvas to enable her to go as a sailing vessel. The yacht, which will be ready in six weeks hence, was named the *Zaria*, by Mrs. Storey, Woking, Surrey.

French Engineers and the City and South London Railway.—Among recent visitors to the City and South London Electric Railway have been a number of French engineers who inspected the line and its system of working, and the machinery by which the electricity is produced, and expressed generally their sense of the value of the undertaking, and of the courtesy with which the details were explained to them. Among the visitors were MM. Ad. Maue, Administrateur de la Cie Chemins de Fer de Bone-Guelma and Prolongements; E. Decharme, Ingenieur du Service Central de la Compagnie des Chemins de Fer du Midi, Professor at the Paris Central School of Arts and Manufactures; A. Biarez, engineer-in-chief of the Nord de l'Espagne Railway; Henri Moffre, engineer of Ponts et Chausees; Louis Etienne, of the same department; Emile Chaperon, engineer of the Paris Lyon Mediterranée; Albert Delaunay, engineer, of Paris; Tony Visinet, and Captain Herbert F. Gye, R.N., General Continental Agent in Paris for the South-Eastern Railway.

Action Against a Traveller.—In the Southwark County Court, on Monday week, the London Battery Company, of Southwark Street, sued Mr. Pope Cox, an electrical engineer, for £18, money said to have been advanced on account of prospective commission. The defendant had counter-claimed for £50, but as he did not appear in person or by counsel, the claim was struck out. The case was heard before his Honour Judge Holroyd and a jury. Mr. Walker, who appeared for the plaintiffs, said that in January last they advertised for a traveller. Defendant replied, and represented himself as a man of experience with a connection. He was engaged by the company, the arrangement being that he was to receive 25 per cent. commission on the gross profits of all orders for installation obtained by him or received by the company, and pending the receipt of orders to be advanced £2 a week on account of commission. He did nothing for four weeks, and then obtained two orders; but his estimate (£38) was so wide of the mark that the company lost £30 or £40 by the transactions. His work in connection with the installations was also very badly done. Altogether he obtained advances to the amount of £18, which the company now sued for. Mr. A. W. Armstrong, manager to the company, and Mr. J. W. Crosby, electrical engineer, having given evidence, the jury returned a verdict for the plaintiffs for the full amount of their claim.

Personal.—We understand that Mr. Alfred E. Ruddock has resigned his position with Messrs. W. T. Goolden & Co., and joined the staff of Messrs. Poole and White.

Theft of Telephone Apparatus.—At Paisley on Wednesday last week Sheriff Cowan sentenced two men named James Ritchie and Isaac Fern to 60 days' imprisonment each for the theft of a large quantity of telephone apparatus from the works of Andrew Erskine Muirhead, telephone contractor, Cart Forge, Crossmyloof. They had previously been employed on the premises.

Continental Telegraph Rates.—A *Daily News* correspondent states that the rate for telegrams between France and Russia has been reduced from 5d. to 4d. a word. Between France and Belgium it was reduced the other day from 1d. a word to 6d. for 10 words. This is probably the cheapest rate yet attained for international telegraphy. It is only a fraction higher than the French charges for inland telegrams.

Electric Lighting in London.—A Committee of the House of Lords, presided over by Lord Basing, last week passed the Bill for the confirmation of the Local Government Board provisional order enabling the Chelsea, New Cadogan, and Belgrave Electric Lighting Company to light a part of the parish of St. Luke's, Chelsea. Other orders relating to the City of London, Clerkenwell, St. Luke's, and Woolwich were unopposed.

Electric Bells.—Tenders are required for making perfect and maintaining in thorough repair for three years the whole of the electric bells and wires, and the apparatus connected therewith, fixed in the land and river stations of the Fire Brigade, and in houses used as lodgings for firemen, for the London County Council. Specification, form of tender, and particulars may be obtained on application at the County Hall, Spring Gardens. Persons tendering must have offices and workshops within the County of London, and estimates must be sent in by the 14th inst.

Vancouver Electrified.—The City of Vancouver, British Columbia, is to have an electric railway and the electric light through the kind offices of Huddersfield. So we learn from a prospectus of £41,237 2s. 3d. Six per Cent. Bonds of the Vancouver Electric Railway and Light Railway, issued by the Yorkshire Guarantee and Securities Corporation, Limited. In many respects this is a remarkable document, and those interested in its contents we refer to a leading article in the *Financial Times* of yesterday. We may add, however, that our City contemporary does not speak in flattering terms of the prospectus or of the auspices under which it is produced.

Revolution in Electric Lamp Manufacture.—Dalziel's Vienna correspondent telegraphs :—"The electrical world of Vienna is greatly excited over the discovery by Captain Franz Walter, lecturer at the Military Academy, of a method of amalgamating glass with other metals than platinum. The invention, which has been patented in every country in the world, will effect a revolution in the manufacture of electric lamps, which will be immensely cheapened by it, as the use of platinum will be entirely discarded. Captain Walter states that his invention will cheapen the manufacture of lamps by 100 per cent., while breakage will not hereafter amount to 5 per cent." But the electrical world of Vienna probably does not know of Mr. Fessenden's process which we describe in another Note.

The Submarine Cables of the world.—M. Vlasto the Deputy Manager to the Société Générale des Telephones writing from Bezons, under date July 6th, says:—In your number of June 5th, you attribute to the *Journal Telegraphique* of Berne, the figures or rather the tables of figures which you publish on page 725, concerning the submarine cables of the world. These tables are not taken from the Berne journal, but from a paper sent by myself to the Civil Engineers last May. I enclose a copy of this paper. My only object in making this correction, is to relieve the Berne journal of the responsibility, and to give you notice that the figures which I have given, are only correct for October 1889. They have been subject to many modifications since that time.

Electricity and Art.—Mr. Jan Van Beers on Wednesday night held a social gathering at the Continental Gallery to welcome his English patrons. Over a hundred guests sat down to supper, which in its way was unique. Astonishing effects were produced by the electric light. The supper table was made of glass, covered with an ordinary white table cloth; underneath 300 incandescent lamps of various shades were placed, which suffused the table with light. Electric lamps were placed in every nook and corner of the room. The installation, which consisted of 575 lamps, was fitted up by Messrs. Mellier & Co., of Margaret Street, Cavendish Square, under the superintendence of their engineer, Mr. W. Lowry. The whole of the work was completed by four men in one day.

NEW COMPANIES REGISTERED.

South American Cable Company, Limited.—Capital, £500,000 in £10 shares. Objects : to establish, maintain, work and use telegraphs, telegraphic, telephonic or other communication, overland as well as submarine, from, in and between South America, Africa, Europe, and islands and places in the Atlantic Ocean ; to apply for, obtain, purchase or acquire any concessions, powers, rights, subsidies, or privileges already granted, or to be granted by the Governments of Brazil, France, Great Britain, or any other country, state, dominion, or dependency, and to undertake and fulfil the conditions or obligations of or incident to any such concessions, powers, subsidies, or privileges ; and to enter into, make, or fulfil, any contracts or arrangements with the above mentioned governments or other authorities, relative to the construction, acquisition, maintenance, letting, hiring, using, or working of any telegraphs, telephones, or other communications. Signatories (with one share each), A. Scott, 149, Leadenhall Street, E.C.; H. Marsham, 28, Bury Street, St. James's, London ; J. W. Silver, Wantage ; R. P. Henderson, 7, Mincing Lane, E.C. ; R. K. Gray, 106, Cannon Street, E.C. ; M. Gray, Abbey Wood, Kent ; A. W. Jarvis, M.P., 120, Mount Street, W. The number of directors is not to be less than three nor exceed seven, the first to be appointed by the subscribers. Qualification, £500. Remuneration, £1,200 per annum and 5 per cent. of surplus profits after 6 per cent is paid, provided that the whole does not exceed £2,400 per annum. Registered on the 4th inst. by Wilson, Bristow and Carpmael, 1, Copthall Buildings, E.C.

County of London Electric Lighting Company, Limited.—Capital, £100,000 in £5 shares. Objects : To carry on the business of electrical engineers, electricians, engineers and contractors, suppliers of electricity, manufacturers of electrical apparatus and mechanical and chemical engineers ; and to produce and supply light, heat, sound and power by electricity, galvanism, magnetism or otherwise. Signatories (with 1 share each) : J. A. Kelman, 251, Winchester House, E.C. ; J. C. Bull, 1 & 2, Great Winchester Street, E.C. ; E. Garcke, 112, Belvedere Road, S.E. ; B. H. Van Tromp, 4, Hyde Park Terrace, W. ; R. Broadhurst, 112, Belvedere Road, S.E. ; G. Parker, 20, Bucklesbury, E.C. ; T. Cooke, Winchester House, E.C. The number of directors is not to be less than 3 nor more than 7, the first to be determined by the subscribers. Qualification, one share. Remuneration to be fixed at the general meeting. Registered on the 30th ult. by S. Morse, solicitor to the company, 4, Fenchurch Avenue, E.C., office, 1, Great Winchester Street, E.C.

International Inventions Corporation, Limited.—Capital, £100,000 in £1 shares (of which 1,200 are founders'). Objects : To carry on the business of bankers and capitalists, either as principals or agents in all their branches, and especially in relation to dealing with inventions and letters patent or patent rights ; and to carry on the business of civil, mechanical and electrical engineers. Signatories (with 1 share each) : W. T. Prestoe, 32, Woodstock Road, Hornsey, N. ; P. J. Rawlings, Avenue Road, New Southgate, N. ; T. Baker, 6, Mount Pleasant Road, Lewisham, S.E. ; E. T. Clarke, 51, Milkwood Road, Herne Hill, S.E. ; H. A. Pinchbeck, 71, Queen Street, E.C. ; W. E. C. Pinchbeck, 71, Queen Street, E.C. ; J. Chinn, 1, Oakden Street, Kennington, S.E. The number of directors is not to be less

than 3 nor more than 9, the first to be appointed by the subscribers. Qualification, 5 founders' or 50 ordinary shares. Remuneration, £150 per annum each, and £100 per annum extra for the chairman. Registered on the 29th ult. by P. J. Rawlings, Avenue Road, New Southgate, N.

Fairmount Syndicate, Limited.—Capital, £80,000 in £10 shares. Objects: to construct, execute, carry out, equip, maintain, improve, operate, develop, administer, manage or control railways, tramways, docks, wharves, canals, reservoirs, embankments, irrigations, sewage, drainage, water, gas, electric light, telephonic, telegraphic, and power supply works, hotels, warehouses, markets or public buildings, and all other works and conveniences of public utility; and to carry on the business of a telephonic and telegraphic company in their respective branches. Signatories (with one share each), G. S. Anderson, 46, Warwick Gardens, W.; R. Blackie, Great Clacton; W. Tozer, Botolph House, Eastcheap; C. Rees, 22, Sylvan Road, Upper Noorwood; A. Cornforth, 3, Manischal Road, Lee, S.E.; G. Schultz, Botolph House, Eastcheap, E.C.; E. F. West, The Rowans, Balham, S.W. The number of directors is not to be less than three nor more than seven, the first being G. S. Anderson, R. Blackie, and C. Bell. Qualification, five shares. Remuneration, £500 and 5 per cent. of the sum available for dividend after 10 per cent. is paid, divided between them but the whole is not to exceed £5,500 without special sanction. Registered on the 29th ult. by Ingle, Cooper and Holmes, 20, Threadneedle Street, E.C.

Perkins, Graham & Company, Limited.—Capital, £10,000 in £50 shares. Objects: to construct, execute, carry out, equip, improve, work, and control railways, tramways, docks, harbours, piers, wharves, canals, reservoirs, embankments, drainage, water, gas, electric light, telephonic, telegraphic and power supply, houses, hotels, markets, and public works of every description. Signatories (with one share each), G. Heathcote, 83, Grosvenor Street, Manchester; S. T. Woodhouse, Abbotsleigh, Knutsford; R. J. Draiden; 174, Oxford Road, Manchester; D. Graham, 12, Bank Street, Manchester; J. Perkins, 38, Coral Street, Manchester; T. Popple, St. James' Place, Heywood; W. Heathcote, 33, Wilmstan Road, Rusholme. The number of directors is not to be less than three nor more than seven, the first being G. Heathcote (chairman), W. Heathcote, S. T. Woodhouse, and J. Perkins (manager, with a remuneration of £5 weekly), Qualification, £500. Registered on the 2nd inst. by Jordan and Sons, 120, Chancery Lane, W.C. Office: 12, Bank Street, Manchester.

St. John, Hampstead, Electric Supply Company, Limited.—Capital, £1,000 in £5 shares. Objects: to carry on the business of an electric supply company in all its branches; in particular to construct, lay down, establish, fix, and carry out all necessary cables, wires, lines, batteries, accumulators, lamps, and apparatus; and to generate, accumulate, distribute and supply electricity and electrical force for the lighting of streets, docks, wharves, markets, theatres, churches, buildings and places, both public and private. Signatories (with one share each), C. J. Wharton, 82A, New Bond Street, W.; F. J. Down, 82A, New Bond Street, W.; A. F. Davies, 82A, New Bond Street, W.; W. Martindale, 82A, New Bond Street, W.; A. J. Ireland, 13, Minet Avenue, Harlesden; A. W. Jones, 87, Balfour Road, Highbury New Park; J. Devonshire, 23, Harrington Gardens, S.W. Registered without special articles on the 1st inst., by H. F. Kite, solicitor to the company, 11, Queen Victoria Street, E.C.

East London Electric Supply Company, Limited.—Capital, £1,000 in £5 shares. Objects: to carry on the business of an electric supply company in all its branches; in particular to construct, lay down, establish, fix, and carry out all necessary cables, wires, lines, batteries, accumulators, lamps and apparatus; and to generate, accumulate, distribute and supply electricity and electrical energy for the lighting of streets, docks, wharves, markets, theatres, churches, buildings and places, both public and private. Signatories (with one share each), C. J. Wharton, 82A, New Bond Street, W.; F. J. Down, 82A, New Bond Street, W.; A. F. Davies, 82A, New Bond Street, W.; W. Martindale, 82A, New Bond Street, W.; A. J. Ireland, 13, Minet Avenue, Harlesden; A. W. Jones, 87, Balfour Road, Highbury New Park; J. Devonshire, 23, Harrington Gardens, S.W. Registered, without special articles, on the 1st inst., by H. F. Kite, solicitor to the company, 11, Queen Victoria Street, E.C.

City of Waterford Electric Supply Company, Limited.—Capital, £1,000 in £5 shares. Objects: to carry on the business of an electric supply company in all its branches; in particular to construct, lay down, establish, fix, and carry out all necessary cables, wires, lines, batteries, accumulators, lamps and apparatus; and to generate accumulate, distribute and supply electricity and electrical energy for the lighting of streets, docks, wharves, markets, theatres, churches, buildings and places, both public and private. Signatories (with one share each), C. J. Wharton, 82A, New Bond Street, W.; F. J. Down, 82A, New Bond Street, W.; W. Martindale, 82A, New Bond Street, W.; A. F. Davis, 82A, New Bond Street, W.; A. J. Ireland, 13, Minet Avenue, Harlesden; A. W. Jones, 87, Balfour Road, Highbury New Park; J. Devonshire, 23, Harrington Gardens, S.W. Registered, without special articles on the 1st inst by H. F. Kite, solicitor to the company, 11, Queen Victoria Street, E.C.

Hampstead Electric Light and Power Supply Company, Limited.—Capital £1,000 in £1 shares (of which 100 are founders). Objects: To carry on in the parish of Hampstead and elsewhere in the United Kingdom, the business of electric lighting; to produce and supply electricity and electrical force; and to provide and supply by means of electricity or electrical force, light, heat, motive power and telegraphic, telephonic or other means of communication. Signatories (with one share each): W. B. D. Cooper, 5, Victoria Street, S.W.; W. Smee, 5, York Buildings, Adelphi; J. Holloway, 9, Pakenham Street, Gray's Inn Road, W.C.; J. Gaskell, 52, Courtfield Gardens, S.W.; J. R. Cheave, Hotel Windsor, Westminster; T. B. Nicholson, 13, Victoria Street, S.W.; R. M. A. Inglis, 5, Victoria Street, S.W. The number of directors is not to be less than three nor more than seven, and until such are appointed the above subscribers shall act. Qualification, £50. Remuneration, chairman £200 per annum, other directors £100 per annum each. Registered on the 30th ult. by R. M. A. Inglis, 5, Victoria Street, S.W.

Wyndham Electric Light Company, Limited.—Capital £1,500 in £1 shares. Objects: To acquire from W. Williams, of Treherbert, Glamorgan, machinery, plant, and a reservoir for the purposes of the company, and to light, both publicly and privately, the village of Blaenrhondda, Glamorgan, with electricity by means of plant, machinery, engines, dynamos, mains, standards, lamps, stock and general effects. Signatories: J. H. Williams, The Farm, Blaenrhondda, 100 shares; W. Williams, Wyndham Hotel, Treherbert, 300 shares; H. James, Smith's Arms, Treherbert 20 shares; J. Thomas, 19, Brook Street, Treherbert, 20 shares; W. Griffiths, 5, Brook Street, Blaenrhondda, 5 shares; R. Hill, Malle, Pontypridd, 50 shares; B. James, 72, Brook Street, Blaenrhondda, 20 shares; all in the county of Glamorgan. Registered, without special articles, on the 6th inst. by Drake, Driver, and Leaver, Limited, 13, New Bridge Street, E.C. Office, Old Bank Chambers, Market Square, Pontypridd, Glamorgan.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Chelsea Electricity Supply Company, Limited.—The following notice was filed on the 13th ult. At the ordinary general meeting of this company held at Draycott Place, Sloane Square, S.W., on the 14th of May, 1891, the following special resolution was duly passed, and afterwards confirmed on the 2nd of June, 1891: "That of the unissued capital of the company, now amounting to 11,512 £5 shares, 6,000 £5 shares, numbered 14,001 to 20,000 inclusive, were created 6 per cent. preference shares."

The annual return, made up to the 28th May, 1891, was filed on the 18th ult. The nominal capital is £100,500 divided into 20,000 ordinary shares of £5 each and 500 founder's shares of £1 each. 8,488 £5 and 416 £1 shares are taken up, upon the whole which the full amount has been called. The calls paid amount to £18,055, and considered as paid on 4,877 £5 and 416 £1 shares—£24,801. Office, Draycott Place, Chelsea, S.W.

Electric Company, Limited.—The following notice was filed on the 18th ult. :—"I have to inform you that a meeting of the Electric Company, Limited, was duly held on the 18th of June, 1891 (pursuant to Section 142 of the Companies' Act, 1862), for the purpose of having an account laid before them showing the manner in which the winding-up of the company had been conducted, and the property of the company disposed of, and that the same was done accordingly.—(Signed), G. C. V. HOLMES, Liquidator."

Bournemouth and District Electric Supply Company, Limited.—The registered office of this company is situate at Observer Chambers, Albert Road, Bournemouth.

CITY NOTES.

India-Rubber, Gutta-Percha and Telegraph Works Company, Limited.

THE half-yearly general meeting of this company was held yesterday, 9th inst., at the Cannon Street Hotel.

The CHAIRMAN (Mr. S. W. Silver) moved that, in accordance with the minutes, an interim dividend of 5 per cent. be paid forthwith, and he felt fully justified in doing so, as the sales during the past half-year in the general branch of business were in excess of last year, which was the largest in amount of any previous year. He also stated that these remarks applied also to the foreign factories. At their last meeting reference was made to a contract for laying 1,700 miles of submarine cable along the Chilian Coast, notwithstanding the many difficulties arising out of the revolution along the coast where this cable had been successfully laid. The greatest credit, he said, was due to the engineer-in-chief, Mr. Hamilton Gray, for his tact and ability displayed in the interests of the company, and for his good judgment, which had been recognised in a substantial way by the official government. During the last few months the telegraph department had been fairly well employed. After her return from Chili, the ss. *Silvertown* had only time to turn round and take on board 1,600 miles of submarine cable for the Western and Brazilian Company. She started a fortnight ago, and was now approaching her destination, the east coast of South America. He had no doubt of their being able at the close of the year to give satisfactory accounts of their operations, notwithstanding the keen competition prevailing. In thanking the shareholders for their attendance, the chairman moved that an interim dividend of 5 per cent., or 10s. per share, free of income tax, be paid on and after the 10th inst.

This was seconded by Mr. BALLANTYNE, and carried unanimously.

Mr. GRAY: The general manager said that the chairman had clearly shown the position of things, as far as he could judge, but he noticed that the chairman had said that the ordinary business of the company was somewhat better than last year. It was, however, very little better, and he was sorry to say that the competition was so great on that part of the business that there was not very much profit on it. He thought it advisable to let the shareholders know this, and he might state that they intend laying a cable between the Coast of Africa and Brazil. They had got a concession from the Brazilian Government which would enable them to do that, and they had started manufacturing the cable. It would keep the wheels going for a little while longer.

Sir WILLIAM WALLACE proposed a vote of thanks to the Chairman and directors, also to the staff generally, for the management of the business.

This was seconded by Mr. HANSEN.

In acknowledging the thanks, the CHAIRMAN stated that it would only increase their interests generally, and as regards the staff, he was sure that any thanks that the shareholders might pass on to them they were quite welcome to.

This terminated the proceedings.

National Telephone Company, Limited.

THE eleventh ordinary general meeting of the company was held at Cannon Street Hotel yesterday.

Mr. F. R. LEYLAND, who presided, said the report gave the main features of the company's transactions last year, which he hoped would be considered satisfactory. Inasmuch as the revenue account, notwithstanding the heavy reductions of rates made in the provinces, left a balance which was an increase upon the one last year. It would enable them to give the same rate of dividend as last year. There had been considerable expenditure in the reissuing of new debenture stock. They all remembered the state of the money market when the issue was made, and after carefully considering the matter they decided to underwrite a portion of it. The cost of that was shown in the report. There had been a great extension of business during the year, and although he had carried it up to the 30th of April he would tell them that the increase of revenue had gone on since then. There had been a steady increase in the number of subscribers. On April 30th they stood at 35,000, and on May 31st they were 36,000. In spite of the reductions in the provinces they had already met the annual revenue. They had, of course, a great deal more work to do, more lines to keep in order, more operators to pay; and they had to make a very large addition for capital expenditure on which they would have to pay dividends to the shareholders. The problem still remained, therefore, how far this increase would go on. He hoped, and figures pointed that way, that by the end of next year the increase would have gone on to such an extent as to provide for all extra expense and make the net revenue and profit just as much as at present. He did not, however, wish to prophecy; he could only point out what the figures seemed to indicate the probable course of things. They must remember that this year's accounts had only to bear the losses of the first four months, next year's accounts would have to bear the losses of the remaining eight months. The point is whether the progressive increase will be enough to make up for the loss. It was perfectly clear the gross rentals would do so, would the net result do so. The directors were still acting upon the policy of developing and improving the company's system. Last year he spoke at considerable length on the subject, and he told them they were making improvements in the bells, &c. They had pushed on with the work, and had completed about one-third of it. Shareholders would understand the difficulty of doing this work, when it had to be done when the daily service was going on, consequently the amount done must be small. It was much more difficult to work under these circumstances than if they had a free hand, and a new system to work upon. With all the care they took in carrying out the improvements, it was impossible to avoid contact between wires. Then, of course, complaints came from the subscribers; but until the work was done, he was afraid they could not avoid it. The speaker, in conclusion, referred to the taking over of the South of England Telephone Company's business, but did not think that comparison of business could be made yet with certainty.

A few questions were put to the chairman from the shareholders; after these were answered, the chairman proposed that the report and accounts be adopted.

Mr. J. STAATS FORBES, in seconding the motion, said the well-grounded complaint which they had from the subscribers arose from circumstances which the directors could not govern. They had to reckon with the complications of a city like London, and also to remember that they had no legal status whatever. This would at once explain why the service in London was not as satisfactory as it might be. They could not substitute "new lamps for old" very readily. They could not reconstruct a system and carry on a business without a great deal of time and patience, the like of which he in the whole course of his experience never had to encounter before. It would be very desirable to give out to the public what was the real cause. The public was not unreasonable; if it only understood the difficulties complaints would be less.

The resolution was then put to the meeting and carried unanimously.

Mr. FAITHFULL BEGG proposed the re-election of the chairman (Mr. Leyland), which was carried.

Mr. Forbes and Col. Raynsford Jackson, as well as the rest of the directors, were then re-elected, as were the auditors.

The Chili Telephone Company, Limited.

THE directors' report to the 31st March, 1891, states that the action in the Chilian court between the vendor American Company and a small minority of its shareholders, referred to in fifth paragraph of the last report, was ready for decision, when, by order of the Government, the courts were all closed, and they have not since been re-opened. As, consequently, the impediment to registration of the company's title has not yet been removed, the business of the company is continued in the name of the vendor company, but without serious damage to this company's interests.

The purchase of the business of the National Telephone Company of Chili, mentioned in the ninth paragraph of the last report, has been completed, and the business of that company, so obtained, has been merged in, and has formed a part of, the business of this company since 1st July, 1890.

After the outbreak of the civil war the business of the company was stopped by order of the Government, which has since had the entire use of those of our lines situated within the districts remaining under its control; but business has been resumed for the public at Iquique and other stations in districts held by the Congress party. On the 31st March, when the present account ended, the public service at Santiago had been suspended for one month and eighteen days. For the loss of business the Government will compensate the company, and $62,000 had, on the 31st March, been received on account of such compensation.

The company's property has sustained damage only in the province of Tarapaca. The ports of Iquique and Pisaqua were bombarded, and several battles fought on land. Some of our instruments were destroyed, and some poles and wires cut down; for this, both parties are held to be directly responsible, as well as for loss of business between January 20th and March 10th, during which period the telephone service there was suspended by order of the authorities.

The outlay on capital account has been large, but it was necessary for the development of the company's business, which has already increased, and will be still further considerably enlarged when the trunk lines are finished. The general manager directs "special attention to the fact that our construction in Valparaiso and Santiago is practically completed," and adds that "we may confidently expect in the future that the expenditure of the past year will bear good results, and that when the present troubles are over, the number of subscribers will be largely increased, with very little additional outlay." From some of the expenditure to connect up towns, no revenue has as yet accrued, because the subscribers have not yet been connected.

Part of the outlay has been in connecting the former "National" system with that previously belonging to the company—for more economical working—and part in supplying heavy fixtures and pole

lines, so that, to complete connections for new subscribers, the small cost of running the wires only will be necessary.

The Traiguen district has been opened up, and this is likely to prove very advantageous to the company. The locality is on the frontier of Chili and the Argentine, and is the centre of the corn district. The whole of the country round there has been very rapidly developed, and when the railroad, which is in course of construction, passes through, it is expected that this district will become extremely important. It is intended to connect Concepcion with Victoria, Collipulli, and Angol, and eventually with Chillan; but the necessary money for the building of these lines must be furnished by those subscribers who will be benefitted by these connections.

The gross and the net revenue of the company show considerable improvement. For the purpose of the following comparison, one-eleventh has been added to the actual figures of the 11 months' working in the year 1889-90.

	1889-90. at 25½d. per $.	1890-91. at 24d. per $.	Increase including "National" business for 9 months.
Income from rentals and profit on work done	£26,310	£38,711	£12,401
Expenses in Chili	15,996	19,506	3,510
Realised in Chili	£10,314	£19,205	8,891
Expenses in London, interest, discount, &c.	3,624	2,111	*1,513
Net	£6,690	£17,094	£10,404
But from these must be deducted the loss (by the depreciation of currency) in the sterling value of the company's liquid assets in Chili	668	3,089	2,421
	£6,022	£14,005	£7,983

* Add decrease.

After all these deductions are made, the balance available for dividend is equal to 7 per cent. per annum upon the paid up capital, as against a distribution of 5 per cent. for the previous year.

In view, however, of the continuation of the Civil War—with very indefinite prospects of its ending—and also in view of the fact that for capital purposes it has been necessary to use, temporarily, the income of the company until the capital exchequer be replenished by further issue of securities—which cannot be done on satisfactory terms at the present time—the directors recommend that no dividend be paid, carrying forward undivided the whole balance of £14,209 10s. 1d. until peace is re-established, and the future of the company becomes more secure.

The company is now in sole possession of the whole field. Its system is already in far better order than ever before. It has established new exchanges throughout the country, and its prospects—but for the revolution—are brilliant.

In accordance with the articles of association, Colonel R. Raynsford Jackson retires from the board of directors, and being eligible, offers himself for re-election. The auditor, Mr. Thomas A. Welton, also retires, and offers himself for re-election.

The New Shanghai Electric Company, Limited.

AN extraordinary general meeting of the above company was held at the office of the secretary on Wednesday, 27th May.

The SECRETARY having read the notice calling the meeting,

The CHAIRMAN said: Gentlemen, the object of the present meeting is to ask you to respond to a call for increased capital, so as to carry out an important proposal for the extension of the company's business. Although there has been steady and satisfactory progress made during the two and a-half years' existence of this company, the figures of this year so far showing a further marked improvement, yet it is manifest to the directors, as well as to others well posted on the subject, that anything like full justice cannot be done to the company without the requisite means to meet all applications. The arc department has not developed much, certainly, though the lighting of the Kinleeyuen wharves is a promising sign, but pending improvements in the arrangement of the lamps will make the light more valuable to the community, and may possibly induce the council to extend the support hitherto given, and so much appreciated by the company. The success of the incandescent light is so fully recognised in the Shanghai Club, as well as in the hongs where it has been so far installed, that a further unmistakable demand has arisen for it, in some cases from very important quarters; and as Shanghai is not a poor community, the first cost does not deter many from adopting a good and steady light which does not hurt or vitiate the air—a too obvious boon in the hot and oppressive weather. In addition to the profit derived from the two systems of lighting, the prospects of future remuneration from the supply of material look promising, as a contract has just been confirmed for the installation of one of the local steamers, and we have to-day been asked for estimates for two others. Under all these circumstances, a capital of some Tls. 47,000 is manifestly inadequate, and the directors hope that, in accordance with the resolution to be brought forward, the present shareholders will subscribe the additional amount to supplement that already promised, so as to complete the Tls. 50,000 odd (or most of it) which is required to place the concern on a stronger footing; for machinery, &c., has to be paid for before any return can be forthcoming, besides which it would doubtless be expedient to purchase the present or more suitable premises. It is true that the shares are at a slight discount, but this can only be because the position and prospects of the company are so little understood; for, excepting unforeseen accidents, there is nothing to prevent the payment of a good dividend, after making fair allowance for depreciation of plant. Apart from the question of capital, another impediment has been the difficulty of obtaining directors versed in the technicalities of electric lighting, but to obviate this, Messrs. Morrison and Gratton have generously come forward to offer their services as consulting engineers, which practically means the scientific management of the company's business, an advantage that cannot be questioned for a moment, as very few are similarly qualified to undertake such a post, and they are prepared to accept a very moderate commission at first, which proves their confidence in its future development. They have carefully gone into all the calculations, every detail at the works being supplied to them, and they are evidently quite satisfied with the result. Hoping that these preliminary remarks in addition to the circular already sent you may explain how matters stand, I will now ask Mr. Morrison to be good enough to formulate his views.

Mr. MORRISON gave a very exhaustive account of the present condition of the company's works and the need for the proposed increase of capital, which he said could not but be beneficial.

A resolution was then proposed by the chairman offering the unissued shares for subscriptions. Mr. Haskell seconded, and it was carried unanimously.

The CHAIRMAN having said that that concluded the business, a vote of thanks was passed to him and the meeting separated.

The Edison and Swan United Electric Light Company, Limited.—The directors have resolved to recommend a dividend of 7 per cent. per annum for the six months ending 30th June, 1891, making, with the interim dividend paid in February last, 7 per cent. for the year, and a further dividend of 10 per cent. in respect of the arrears of cumulative preferential dividend, to be distributed in accordance with the articles of association. Notice is given that the eighth ordinary general meeting of the shareholders will be held at the Westminster Palace Hotel, Victoria Street, London, S.W., on Tuesday, the 21st day of July, 1891, at 12 o'clock noon, to transact the ordinary business of the company.

The Direct United States Cable Company, Limited.—The board have resolved to recommend a final dividend of 3s. 6d. per share, free of income tax, such dividend to be payable on and after the 24th inst., making, with the interim dividends already paid, 3½ per cent. for the year ending 30th June last, carrying forward a balance of £3,502 1s.

Eastern Extension, Australasia and China Telegraph Company, Limited.—An interim dividend for the quarter ended March 31st last of 2s. 6d. per share is payable on the 15th inst.

St. James and Pall Mall Electric Light Company, Limited.—The Stock Exchange Committee have appointed a special settling day, namely, Tuesday, July 14th. Ordinary shares Nos. 101 to 18,780 and preference shares Nos. 20,081 to 30,080.

Babcock and Wilcox, Limited.—Letters of allotment and regret to applicants for shares have been posted.

TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ended July 3rd amounted to £5,028.

The City and South London Railway Company. Traffic receipts for the past week, were £719.

The Cuba Submarine Telegraph Company, Limited. The receipts for the month of June show an increase of £176 as compared with the corresponding month of last year.

Direct Spanish Telegraph Company, Limited. The estimated traffic receipts for the month of June, 1891, are £1,882, as against £2,085 in the corresponding period of last year.

The Great Northern Telegraph Company. Receipts in June, 1891, £27,400; 1st January to 30th June, 1891, £141,400; corresponding months 1890, £130,400; corresponding months 1889, £124,400.

The Western and Brasilian Telegraph Company, Limited. The receipts for the week ending July 3rd, 1891, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brasilian Company were £3,563.

The West Coast of America Telegraph Company, Limited. Traffic receipts for the month ending 31st March, 1891, £3,250; April, £600; May, £1,275; June, £1,575. The southern cables are still interrupted owing to the revolution in Chili.

The West India and Panama Telegraph Company. The receipts for the mont of June show a decrease of £1,673 as compared with the correspondin month of last year.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (July 3).	Closing Quotation. (July 9.)	Business done during week ending July 9, 1891. Highest.	Lowest
250,000*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	98 —101 xd	98 —101 xd	99½	...
1,381,380*l*	Anglo-American Telegraph, Limited	Stock	45½— 46½	45½— 46½	46½	45½
2,809,310*l*	Do. do. 6 p. c. Preferred	Stock	84 — 85	84 — 85	85	84
2,809,310*l*	Do. do. Deferred	Stock	10⅜— 11¼	10⅜— 11¼	11¼	11
130,000	Brazilian Submarine Telegraph, Limited	10	11⅛— 12 xd	11⅛— 12 xd	12	11⅝
84,500*l*	Do. do. 5 p. c. Bonds	100	101 —104	101 —104	102½	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	103 —107 xd	103 —107 xd	...	...
63,416	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	2⅜— 2⅝	2⅜— 2⅝	2⅝	2 9/16
63,416	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	1⅝— 1¾	1⅝— 1¾	1¾	...
50,000	City and South London Railway, Nos. 1 to 50,000	10	4 — 5	4 — 5	...	...
$7,216,000	Commercial Cable, Capital Stock	$100	103 —107 xd	103 —107 xd	106⅜	105½
224,850	Consolidated Telephone Construction and Maintenance, Limited ...	14/-	7/16— 9/16	7/16— 9/16	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Preference Shares, Nos. 1 to 20,000	Stock	4 — 5	4 — 5	...	...
16,000	Cuba Telegraph, Limited	10	10½— 11½	10½— 11½	10⅝	...
6,000	Do. do. 10 p. c. Preference	10	17 — 18	17 — 18	18	17⅜
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	3⅜— 4¼	3½— 4	3⅜	...
6,000	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10	...	...
60,710	Direct United States Cable, Limited, 1877	20	10½— 10⅝	10⅝— 10⅞	10⅞	10⅝
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅝— 17⅝	14⅝— 15	15	14½
70,000	Do. 6 p. c. Preference	10	15 — 15½	15 — 15½	...	...
200,000*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	107 —110	107 — 110	108¾	108¼
1,200,000*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	106 —109	106 —109	107	...
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	14⅝— 15½	15 —15½	15½	15 1/16
91,800*l*	{ Do. 5 p. c. (Aus. Gov Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 }	100	101 —104 xd	101 —104 xd	103½	103
325,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	101 —104 xd	101 —104 xd	101¾	101½
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	105 —108	105 —108	107	...
135,000*l*	{ Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343 }	100	101 —104 xd	101 —104 xd	105	...
180,400*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	101 —104 xd	101 —104 xd	105½	...
201,600*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	99 —101	99 —101	100½	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	3½— 4½	3 — 4	...	...
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	4½— 5	4½— 5	...	...
66,750	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	2 — 2½	2⅛— 2⅜	2 1/16	2⅛
70,000	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	3¼— 3⅜	3¼— 3⅜	3⅜	3 1/16
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	1½— 1⅝	1½— 1⅝	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 — 3	2 — 3	...	...
180,227	Globe Telegraph and Trust, Limited	10	9½— 9⅝	9½— 9⅝	9⅝	9½
180,042	Do. do. 6 p. c. Preference	10	15 — 15½	15 — 15½	15 13/16	15
150,000	Great Northern Tel. Company of Copenhagen	10	18½— 18¾xd	18½—18⅝ xd	18⅝	18⅝
230,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 —108	105 —108	...	...
9,334*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	10 — 11	8 — 8½	...	...
5,334*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	10½— 11½xd	10 — 11 xd	...	...
41,600	India-Rubber, Gutta Percha and Telegraph Works, Limited ...	10	19 — 20	19 — 20	19⅜	19½
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	103 —105	103 —105	...	...
17,000	Indo-European Telegraph, Limited	25	39 — 41	39 — 41	40½	39½
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	7½— 8½	7½— 8½	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	9¼— 9⅝	9¼— 9⅜	...	...
38,348	London Platino-Brazilian Telegraph, Limited	10	6½— 7½	6½— 7½	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	106 —109	106 —109	...	...
43,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	9⅜— 10½	9⅜— 10½	10½	10
438,984	National Telephone, Limited, Nos. 1. to 438,984	5	5 — 5¼	5 — 5¼	5⅛	5
15,000	Do. 6 p. c. Cum., 1st Preference	10	12⅜— 13½	13 — 13½	13½	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	12 — 12½	12¼— 12⅜	...	...
350,000	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	103 —105 xd	104 —106 xd	105⅜	104½
6,318*l*	Notting Hill Electric Lighting Company, Limited, £8 paid ...	10	4 — 5	3½— 4½	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	¼— ⅜	5/16 — 7/16	...	...
9,000	Reuter's Limited	8	8 — 8½	8 — 8½	8¼	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	...	6¾— 7¼	...	...
7,900	Do. do. do. 7 per cent. pref.	2	...	3¼— 3⅜	...	...
3,381	Submarine Cables Trust	Cert.	114 —118	115 —120	116½	115½
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	4½— 5	4½— 5	4⅝	4½
37,350	Telegraph Construction and Maintenance, Limited	12	46 — 48	45 — 47	47½	45
150,000*l*	Do. do. do. 5 p. c. Bonds, red. 1894	100	101 —104 xd	101 —104 xd	...	...
58,000	United River Plate Telephone, Limited	5	2½— 3½	2½— 3½	...	...
146,128*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	85 — 95 xd	85 — 95 xd	...	...
3,200*l*	Do. do. 7 p. c. Debs., Nos. 1 to 1,000 ...	100	... ...	... ...	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	8 — 9	8 — 9	...	...
290,900*l*	Do. do. do. 5 p. c. Debentures	100	95 — 98	95 — 98	96½	95½
30,000	West Coast of America Telegraph, Limited	10	3½— 4½	3 — 4	3½	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	96 —101 xd	97 — 102xd	99	...
64,174	Western and Brazilian Telegraph, Limited	15	11½— 12	11¼— 11⅜	11⅝	11⅜
27,873	Do. do. do. 5 p. c. Cum. Preferred	7½	6½— 7	6½— 7	6⅝	6 11/16
27,873	Do. do. do. 5 p. c. Deferred	7½	4½— 5	4½— 5	4 11/16	...
200,000*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	103 —106	104 —107	...	...
250,000*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	103 —106	103 —106	107	104½
88,321	West India and Panama Telegraph, Limited	10	2⅜— 2⅝	2⅛— 2⅜	2 5/16	2 3/16
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	10 — 10½	10 — 10½	10⅜	10¼
4,669	Do. do. do. 6 p. c. 2nd Preference ...	10	9 — 10	9 — 10	...	...
$1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	117 —122	117 —122	...	...
175,100*l*	Do. do. 6 p. c. Sterling Bonds	100	100 —104	100 —104	...	...
42,853	*Westminster Electric Supply Corp., Ord., Nos. 101 t ‹ 42,[illegible]3 ...	5	4⅜— 5¼	4⅜—5¼	5 3/16	...

* Subject to Founders' Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7¼—7⅜.—City of London Electric Lighting (Pioneer), Shares of £50, fully paid, 50—52.—Elmore's Austrian Copper Depositing, 15s., 25s.—Elmore's Priorities, 3¾—4¼.—House to House Company (£5 paid) 4⅜—5½.—Liverpool Electric Supply, £3 paid, 2⅜—2¾.—London Electric Supply Corporation, Ordinary (£5 paid), 1¾—1⅞.—Manchester, Edison and Swan Company, £9 (£1 paid) 2s 6d.—5s.—National Telephone Debentures, 2½—3 prem.—Woodhouse and Rawson Ordinary of £5 (£2 10s. paid), 2½—2⅝.—£5 Preference, fully paid 3⅞—4⅛.—Debentures 90—95.—Wards Electric Car, £10 paid, ⅝—1.

BANK RATE OF DISCOUNT.—2½ per cent. (2nd July, 1891).

THE PROGRESS OF ELECTRICITY.

(*Concluded from page* 18.)

I have taken all the companies in London and have tabulated the revenue derived by each company per lamp per annum, for a 33 watt light and a 10-candle burner, and I find that the Metropolitan Electric Supply Company derive a revenue of 12s. per lamp, the Chelsea Electric Supply Company 8s. 6d. per lamp, the Kensington and Knightsbridge Company 9s. 2d. per lamp, the House-to-House Electric Supply Company 11s. 6d. per lamp, St. James's and Pall Mall Electric Supply 9s. 6d. per lamp, and a company in Brighton charges 8s. 6d. per lamp; the mean being for 200,000 lamps 10s., which compares with 9s. for gas. Well, I have also verified this ratio between the two lights, and in the General Post Office where we burn a great quantity, and where night operations are extended to late hours, and we begin at early hours, there, from the experience of two years' working and comparison, we find that gas costs 18s. per lamp per annum and electricity 22s., the ratio being 9s. and 11s. and not 9s. and 10s. as with the companies. Take the case of Manchester, where gas is cheaper than in London. The average price paid per lamp for gas in Manchester is 7s. 6d. per annum. Well, taking the cost of electricity at 4d. per unit, the revenue that Manchester will derive from public lamps will be 8s. 4d. per annum against 7s. 6d. for gas. Of course the rates of charges vary very much in London, the private companies are charging 7d., in other instances 8d. per unit. In Bradford they commenced by charging 5d., and have since raised it to 6d. In Newcastle they are charging 4½d. to the public, and they are allowing large discounts on that 4½d. to the large users of electricity. We in the Post Office are large users, and we have a discount of 20 per cent. off that 4½d., which makes the cost of our electric lighting in Newcastle very nearly approaching that of gas. In factories where they have isolated installations all the facts show that electricity is cheaper than gas. I have figures for Bolton, from Messrs. Horrocks, Crewdson and Company, who are amongst the largest employers of labour in that district. They have had the electric light going for six years, and while they were using gas the cost per lamp per annum came to 5s. 6¾d. Since they have generated their own electricity it comes out that their lamps cost them 4s. ¼d. per annum, so there is a considerable reduction. Those who know Manchester know that under the Exchange there is a large restaurant which used to be unbearably hot when lighted with gas. The manager two years ago replaced gas by electricity, and finds he has not only saved £800 a year in the cost of the light, but has probably doubled his income by allowing his guests to have their meals in comfort. So far as figures go, I have given you hard facts to show there is not much difference between electricity and gas. I tell all my friends that my house is lighted by gas, but I burn my gas in the garden, and allow all the vitiated gases to disappear in the air, while I extract from the gas what I want—light, and have it in my house. If you take 25 cubic feet of gas and burn it direct, you will only get 50 candles of light. If you burn your 25 cubic feet of gas in a gas engine and produce electrical energy, it will give you 160 candle-power of light in the house. So with a little care you are able to still use the gas and treble the amount of light in the house. I see in the programme you are going to the Royal Naval Exhibition. The Royal Naval Exhibition is lighted by electricity. There is an engine room there fitted up with probably the latest developments of electrical machinery. Electrical machinery is constantly changing; we are daily producing improvements of some kind or the other. The electrical room there is well worth your visit, and you will see there how the electrical energy is generated, and will probably find that one dynamo and one engine is supplying light to the whole of the Exhibition. On Saturday you are going to have a still more interesting visit to the works of the Electric Supply Corporation at Deptford. They are not complete, but there you will see preparations that are being made for lighting 1,000,000 lamps in London. At the present moment they have only sufficient machinery to allow of 200,000 lamps going. You will find there the space required for electrical machinery to light a million lamps. One of the great merits of electrical machinery over gas machinery is the small space which it uses. Gas requires 100 feet by 50 feet for every million cubic feet made per annum; with electricity 100 feet by 50 feet is quite sufficient to light up one of our big towns. We must not neglect other points. We must not neglect the fact that when we deal with electric lighting we are removing from our midst a source of deterioration to our goods, chattels, and pictures, we are removing something which destroys our decorations and discolours our ceilings, and we are introducing into our houses something which encourages cleanliness. We add to our comfort, and by adding to our comfort we add very much to our cheerfulness. There is nothing which makes us pass through life with so much comfort to ourselves as cheerfulness after meals. I know nothing which adds so much to the cheerfulness of our lives as the electric light. I feel it will add to our lives. I feel if I had not had the electric light in my house for eight years I should not now be addressing you. I feel when you again meet in London, ten years hence, I shall be able to come and address a much larger body, for you will then be electrical engineers as well as sanitary engineers, and give you experience of the progress which has been made in electric lighting. Another point is that it adds so much to the security of our buildings. It is not absolutely safe; it would be absurd to say it was. Carelessness and folly will cause fire by electric current as by gas. It requires supervision and the usual care which engineers know so well how to exercise. But it is this question of health which I want to thrust down everybody's throat as the great merit of electric lighting, if the price is very great indeed. We find in the Savings Bank Department of the General Post Office the cost of the electric light is paid for by the increased work we get out of our staff. The introduction of the electric light has diminished the hours of absence two hours per day per annum. That put down at 10d. per hour, which is the ordinary overtime rate in Government service, means we save £680 a year. Our electric light costs us £700, so it is really only costing us £20 a year. So in the General Post Office we succeeded in putting in electric light just before Christmas, and the Chief Controller told me the electric light enabled them to get out their work quicker than ever before, and it was quite equal to 200 men. The purity of the air you breathe—the sanitary aspect of the electric light—is the point and aspect which commends it so much to municipal engineers and local authorities. We must not forget that when gas is let into the air, the impurities in it are poisonous. Gas burned in a bedchamber is as injurious as bad water and bad smells. The chief duties of the municipal engineer have been to improve the sanitation of our towns, and to remove vegetable and decaying matter from our water supplies. But the duties of the municipal engineer will not be complete until he takes in hand the electric light. There is one other point I want to urge upon you, that is, that it is not the lamp of luxury. The common argument is that it is the lamp of luxury, that it is only the rich man who can afford to pay for it. The electric light is the poor man's light. If you can get the light for 8s. 4d. per lamp per annum, it is to the benefit of the working man who has to live in small ill-ventilated rooms to have the light in his home. Now, the price of gas is going up; the price of electricity is coming down. The price of gas is going up from labour disputes and strikes; the price of electricity is coming down, because we know so very much more about it. I have not said very much about the relative cost of production of gas and of the electric light. We can produce 1,000 feet of gas for 1s. 10d.; the extra 2d. is for management and collection, though I have no doubt that gas engineers will claim to be able to produce it for 1s. 7d. or 1s. 4d. or 1s. per thousand feet. What can we produce electricity for? I have just been making a most exhaustive enquiry into the cost of electricity in the production of phosphorous and copper. They are two industries where the use of the current is continuous. You have your engines, dynamos, and everything working at its maximum efficiency. In electric lighting the load is irregular. People will not go to bed at the same hour, or rise at the same hour, so your load line is variable. Where your load line is constant, as in the production of copper and phosphorous, you can produce your electricity for one-third of a penny per unit. There is no mistake about that figure. The cost of production of a unit of electricity, with a constant load, is but one-third of a penny. What does that mean? If we take the theoretical difference betweeen gas and electricity, it is equivalent to gas produced at 3d. per thousand feet. When we have the prospect of producing electricity at one-third of a penny, equivalent to gas at 3d. per thousand feet, it shows what a vast field of development is before the electric light. There is one reason why gas is still ahead of electricity. It is that there is such a market in this country for residuals. The price obtained for coke, and ammonical liquors, and the other ingredients of gasworks, practically reduces the price of coal in London to the gas manufacturer to 4s. 6d. per ton. We have to pay in London for Welsh coal 23s. per ton. That is why we have to pay more for the electric light than for gas. When we come to places like Gibraltar and Malta, where I went to see whether it was possible to use the electric light instead of gas, where there is no market for residuals, it required no difficulty on my part to say that it was possible to produce electricity cheaper than gas. I have endeavoured to the best of my ability to bring this matter before you as practical men, and I want you, if you agree with my conclusions, to point out to your different boards that the duty of a corporation is to look into this matter, not only from a financial, but from a political as well as a sanitary, but above all from a philanthropic point of view, and endeavour to persuade, as I have endeavoured to persuade you, that the electric light is not the light of luxury, but the poor man's lamp. (Applause.)

The PRESIDENT, in proposing a vote of thanks to Mr. Preece, said they had listened to a very interesting address from, he was going to say, a great electrician, as he considered Mr. Preece when he came into the room, but he would alter that term and say a great sanitary engineer. It struck him in looking at the figures of electricity—he was interested in one of the first electric installations in London, the experiments at Holborn Viaduct—that they must look forward to the time when electricity would replace gas very largely, if not altogether, for lighting purposes.

Mr. LEMON (Southampton), in seconding, remarked that one of the most regrettable events of his career was his failure to induce his corporation to adopt the electric light.

The vote of thanks was accorded with acclamation, and was acknowledged by Mr. Preece.

THE EDISON ELECTRIC LIGHT COMPANY v. THE UNITED STATES ELECTRIC LIGHTING COMPANY.

(*Continued from page* 17.)

ARGUMENT OF GEN. S. A. DUNCAN.

Upon the opening of court on May 28th, Gen. S. A. DUNCAN commenced his opening argument for the defendant. He said that he apprehended it might at the outset be well to get a clear conception of the problem which Mr. Edison undertook to solve in connection with electric lighting. Was that problem the mere invention of a lamp, or was it one of a broader and more complex nature, calling for invention not in one direction but in a hundred? The bill of com-

plaint had stated that Mr. Edison addressed himself to the work of inventing a complete system of electric lighting, capable of competing with other forms of illumination, adaptable to general use. It declared that this work necessitated the perfection of many distinct apparatuses—generators, conductors, instruments for regulating the quantity and pressure of the current, meters, lamps, sockets and holders, with many other accessory devices, the whole having been perfected only after many experiments, and frequently embodying distinct inventions. Mr. Edison was early in the field, after the great impulse in the domain of applied electricity which arose from the perfection of the dynamo machine; he had been backed by a powerful syndicate furnishing him with abundance of money, and the results of his labours in the solution of this complex problem are found in the large number of patents subsequently issued to him. In November, 1882, for instance, a circular issued by the Edison company gave a list of no less than 150 patents relating to this system, and many others followed in subsequent years. As early as 1883 the Edison company were attaching to the packages in which their lamps were sent out labels professing to indicate the lamp patents under which the company were licensed, 121 in number. Mr. Edison's own account of what he undertook to do is as follows:—"The problem, then, that I undertook to solve was, stated generally, the production of the multifarious apparatus, methods and devices, each adapted for use with every other, and all forming a comprehensive system whereby electricity, properly controlled and directed, could be distributed over large areas through the streets of a city, and supplied to houses in which it would feed incandescent electric lamps of moderate candle-power, which would be entirely under the control of the householder, the whole to be on the same scale as the present system of gas distribution, and affording the same character of convenience to the users."

But other inventors were at work upon this problem contemporaneously with Mr. Edison, and were as early in the field as he. Among them were gentlemen associated with the United States Electric Lighting Company, the defendant in this suit, which had a commercial plant in operation in New York as early as November, 1880, the first central station plant in this country. General Duncan thought he was correct in saying that according to the records no lamps were sold by the Edison Company in 1880, nor until after the organisation of that plant by the defendant corporation.

Mr. LOWNEY here stated that the manufacture of lamps was not carried on at that time by the Edison company, but by the Edison Lamp Company.

General DUNCAN, resuming, said that manufacture was begun by the United States Company that year, and that it had sold not less than 36,437 lamps to March 31st, 1882, while the Edison Company to January 1st, 1882, had sold but 34,597; this shows that those concerns, not to speak of others, were simultaneously at work upon this problem. The Edison Company had behind them as inventor Mr. Edison; the other company had other inventors; each had accumulated a large number of patents. Mr. Hebard says his company owned 131 patents in 1885. Yet the proposition of the Edison Company is, that a single one of the hundreds of patents it owns controls the situation, and through that one patent they propose to throttle this magnificent industry; the tens of millions of dollars invested by other companies is to be destroyed absolutely at the dictation of this company, under this one patent, which is only one of the elements in the general system. From that great mass of hundreds of patents, they single out this one, and say that it is that which solves the whole problem of the subdivision of the electric light. As to the interpretation of that patent, General Duncan said, he would take issue with his friends on the other side. His position was that it produced substantially no impression upon the art; he was willing to credit Mr. Edison whatever was his due by reason of the industry he had displayed, the persistence with which he had pursued the solution of the problem he had set before himself, and the large number of inventions he had made. But they were not now trying the value of any of the other inventions, but whether this one invention was the foundation of all Mr. Edison had done. In passing, he would remark that this was not the only suit pending in this court by this plaintiff against this defendant; there were 29 other suits, involving a dozen other of the multitudinous patents of the Edison Company, and two or three of these were also styled fundamental patents. Probably if this suit should fail, the Edison Company would appear at a final hearing at no distant date, declaring that the inventions patented in the patents there involved were the inventions that solved the problem of electric lighting; that was their position as declared in a New Jersey suit, in which a patent for the distribution of current was involved, and in which a very intelligent expert called by the Edison company, when asked whether the invention here in issue did not play an important part in the solution of the problem of sub-division had said, "Why the lamp had something to do with the solution of the problem, but lamps enough were known to the world before the invention of Mr. Edison's carbon filament, which would have been good practical commercial lamps if only Mr. Edison's system of distribution had been known in the world, and when Mr. Edison invented that he solved the problem of electric lighting."

Before examining the prior state of the art, Gen. Duncan said he desired to call the attention of the Court to one expression found in the patent as follows: "In general the attempts of previous persons have been to reduce the resistance of the carbon rod." This can mean but one thing—that previous experimenters or manufacturers of lamps undertook to reduce the specific resistance of the carbon burner, not the total resistance. It seemed to him important that that distinction should be kept sharply in mind throughout the whole discussion. After explaining the difference between specific and total resistance, General Duncan said that most of the work in electric lighting prior to Edison's day had been in arc lighting, and the manufacturers of the pencils sought to make the specific resistance as low as possible in order not to waste energy in passing the current through the pencils. Such pencils were made by well known processes for various purposes. They were made large and small, and were for sale in Paris and elsewhere; some as small as a millimetre in diameter. Undoubtedly King and Lodyguine, and later Sawyer and Man in their first experiments purchased for their work on the incandescent lamp such carbons of low specific resistance. That was what this statement in the patent meant; it could not have been true in any other sense, for it was not true that any who were at work in incandescent lighting sought to reduce the total resistance of the burner to the lowest point. Such an interpretation would do violence to well-known laws of electricity familiar to all, and would be at variance with the plain teaching of all the patents illustrating the prior state of the art. If any man had undertaken to make electric lamps on the theory of reducing the total resistance of the burner to a minimum, he would quickly have found himself mistaken, however ignorant he might have been of the laws of electricity. That brought him to make a proposition, which he would suggest as a valuable one to carry through the discussion, and to explain many things which might otherwise seem confusing. High total resistance is, and has always been known as desirable for the burner of an incandescent lamp, whether to be used alone, in series, or in multiple arc. There was no mystery about it; the whole principle underlying the incandescent lamp is that of a continuous circuit traversed by the current. If one part of the circuit is of higher resistance than the rest, more heat is developed at that point; the higher the relative resistance the more heat is developed and the more light is obtained. It is wholly immaterial whether the circuit contains one lamp or fifty lamps in series, or fifty lamps in multiple arc. The term high resistance used in this art is a merely relative term; it is high total resistance; the resistance of that part of the circuit in which useful work is done as compared with the resistance of all the other parts. The essential thing in making an incandescent lamp is to interpose in the circuit at the point where the light is wanted, a resistance body whose total resistance shall be high relative to that of the other parts of the circuit, and the higher that ratio the more economical will be the performance.

In applying this established rule that high total resistance in the lamp is desirable in any case, certain limitations were met with; for example, in adding lamps in series, a point is ultimately reached requiring a current of so high electromotive force as to be dangerous to handle; but in the multiple arc arrangement, there being no increase of electromotive force, as in the case of the lamps in series, the resistance of the individual lamps may be made much higher. The principle can here safely be carried out to the uttermost, making the lamp of as high resistance as possible, but even then limitations were reached. One of them is that material cannot be manipulated to get an exceedingly high resistance, and yet keep down the radiating surface; but nothing in all that militated against the general proposition that from the beginning it had been a recognised principle that high total resistance was desirable, no matter how the lamp was to be used. A parallel case was that of Morse, who, although he had devised an apparatus for transmitting signals by electricity, sending impulses through the low resistance coil that surrounded his magnet, found that if this was placed near the battery his signals were recorded, but, if he interposed a long wire between the battery and his receiving instrument, he was not able to get a signal. Why? Simply because the resistance of his magnet, the working part of his circuit, was not high enough relatively to the other parts. Some one said, "Put in one of Henry's high resistance magnets, with a large number of coils of very fine wire, making the resistance of that part of the circuit high relatively to the other parts, and thus concentrate the energy of the current at that point," and the work was done. If it is desired to do work of any kind, put a relatively high resistance at the point where the work is to be done. In that respect there is no mystery in electric lighting. It is on a par with all the other domains of applied electricity in which work is to be done. These principles were perfectly understood in applied electricity, and the man engaged in producing electric light in the year 1878, who had not applied these rules, would have written himself down as one not skilled in the art.

Gen. DUNCAN said that he would next consider the prior state of the art, for it was only thus that it could be determined what the real invention was to which the claims of the patent relate. Mr. Edison seems to be very explicit that the date of his invention was October 21st, 1879. He would assume that this invention was not broadly for putting a carbon burner into a high vacuum, nor for a very slender burner in a high vacuum, independent of the material, for these were old in the art. The question is, when did Mr. Edison invent the lamp which depends for its virtue upon that particular form of carbon to which he has given the undefined and undefinable name of "filaments?" Not before the 21st October, 1879. Mr. Edison's testimony tended to confirm this assumption as to date of the invention.

One of the first things he wished to call his Honour's attention to was the Geissler tube. In a general way the Geissler tube consisted of a hollow vessel of glass exhausted to a high vacuum; electrical conductors are passed into the tube and sealed by fusion. (Here several specimens were handed to the Court.) He called attention to Mr. Edison's French patent of June, 1879, in which was illustrated and described an incandescent lamp, which was simply a Geissler tube. Mr. Edison, therefore, recognised, among the incandescent lamps of the world, a Geissler tube. This Geissler tube shows a receiver entirely of glass in the second claim of the patent. It shows also fine platinum wires conducting the current into a highly exhausted chamber. These features of construction appeared elsewhere in other instruments that came into the art later than the Geissler tube. Faraday's *Chemical Manipulation*, published in 1831, describes, with great minuteness, how to manipulate the blow pipe, the wire and the

glass, in order to accomplish this result. He would next briefly consider Crookes's radiometer, described in articles in the "Philosophical Transactions" of the Royal Society from 1874 to 1878. One form of radiometer, described by Crookes, was the Edison lamp of the patent, with the exception, as far as he knew, of the carbon filament. He did not know what the carbon filament was, but it was not in this instrument, because there was no carbon. But there was the high vacuum, the all glass globe, the fine platinum leading-in wires, and the burner inside. Now that was a lamp, not intended for general illumination, but for certain special purposes. But, nevertheless, it embodied in its construction principles which Mr. Edison professes to have discovered and embodied in the lamp he devised for general purposes of illumination.

In another part of Crookes's paper the conclusion must be drawn that Crookes found that a high vacuum could not be maintained in a chamber of glass made of two pieces united by mechanical means, fusion must be resorted to. The testimony of Dr. Adams in the present case shows that he had employed the same expedient ten or twelve years before Edison. He would also call the attention of the Court to the record of the applications in 1881 by one Freeman, in which the applicant showed an incandescent lamp having a carbon burner in an all glass globe, highly exhausted, with platinum leading-in wires. Freeman was put into interference with this very patent of Edison's. He had cited against him King's English patent, and he amended his claim in view of the King patent so as to read as follows:—"An electric lamp for giving light by incandescence, consisting of a strip or filament of carbon of high resistance enclosed within an exhausted receiver made entirely of glass, and attached to metal wires passing through and sealed into the glass, as set forth."

An interference was declared between him and Edison, and at a later date the interference was suspended by the Commissioner of Patents, in order that this radiometer of Crookes might be cited as a reference. The Patent Office in this communication says: In view of the newly-discovered reference found in the "Philosophical Transactions" for 1876, page 351 and 1874, page 513—the form of radiometer above mentioned—"the above-named application has been suspended from interference in order that it may be rejected."

"It is not deemed material that applicant claims a carbon filament in place of a platinum conductor shown in the reference, the substitution of one for the other being a matter within the skill of one well versed in matters pertaining to electric lighting, it being old in the art to use carbon conductors for incandescing lamps."

On re-examination and reconsideration of the matter, the action of the office was reaffirmed. Apparently this publication of Mr. Crookes was not known at the Patent Office at the time Mr. Edison's patent was allowed. Certainly it would be as pertinent against Mr. Edison's application as against Mr. Freeman's.

General DUNCAN then referred to King's Patent (with which most persons are acquainted), where it states when carbon is used a torricellian vacuum is necessary, and recognises the advantages of carbon over platinum. King again says: "When the apparatus is *suitably sealed* it may be applied to submarine lighting, &c." The defendants' witnesses say "suitably sealed" means sealed in such a way as to make it a portable instrument. Prof. Brackett, who was brought forward to contest this view, when asked whether it would require any invention to seal a platinum wire into the glass for the lower connection in the same manner as the upper wire, answered that it probably would not.

The special features of King's patent were: That carbon had peculiar and suitable properties for burners of incandescent lamps; the protection of the carbon by enclosing it in the most perfect vacuum that could be made; the necessity of having a small section to the burner; and that when platinum wire passes through glass it is to be sealed by fusion.

Roberts's English Patent also says if the vacuum be perfect no combustion will ensue.

There is a very interesting patent of Mr. Edison's to which special attention should be called. The date of application is June 30th, 1880, and Mr. Edison says that it is adapted for lamps having a large radiating surface. It is strikingly like the old King lamp of 1845. the lower part of the glass receiver instead of being closed by a fusion of the glass upon the leading in wires, is extended into two long barometric tubes, and the leading wires run down into the mercury in these tubes. Edison says with reference to this kind of seal:

"For high candle-power incandescent lamps this arrangement makes a very reliable and durable seal, obviating any danger there may be of seal breakage arising from difference of expansion coefficient likely to exist where a large metallic conductor is sealed directly into the glass. For such reasons, for large lamps, this method may prove preferable to that of sealing direct, as shown in some of my prior applications."

In view of that patent we trust our friends upon the other side will not say that the King lamp is to be thrown out of consideration by the Court because, forsooth, you could not maintain a vacuum in it.

(To be continued.)

BROWN'S ROTARY EXPANSIVE ENGINE.

THE following report has been made by Prof. Jamieson on this engine for Mr. Brown.

Having been requested by you to test and report upon your latest "Improved Rotary Engine," I went to Messrs. Lang & Son's Tool Works, Johnstone, on the morning of Wednesday last, the 27th May, with two assistants, where I found the boiler, engine, and all the necessary instruments in perfect order.

GENERAL DESCRIPTION OF ENGINE AND BRAKE GEAR.

Before giving the details of my tests, I will describe briefly the general features of engine and the brake gear adopted, by aid of the accompanying photo-lithograph from a freehand sketch made by Mr. J. H. Oswald Brown, artist, on June 4th, prior to my taking the second set of indicator cards.

DETAILS OF CYLINDER AND VALVES.

The chief points of novelty about your engine are the cylinder, piston, and valves. The cylinder is only 10·5 inches diameter by 8·625 inches in length, or 746·9 cubic inches. The cross area of the piston is 40·5 square inches, and its length is 8·625 inches, or 349·3 cubic inches; so that it occupies nearly one-half of the volume of the cylinder.

The cylinder receives steam twice during each revolution of the piston from two cylindrical rotating valves fixed to the valve spindles, V S_1, V S_2, which are placed diametrically opposite to each other, and respectively between the steam pipes, S P_1, S P_2, and the cylinder valve doors. The valve spindles are driven by the valve gearing, V G_1, V G_2, from a pinion keyed to the central shaft, S. They can be adjusted so as to cut off the steam at any desired point of the piston's revolution, or they may be connected to a governor so as to maintain a uniform speed under widely different variations of load and steam pressure.

Two oscillating valve doors, keyed to the spindles, V D S_1, V D S_2, form part of the circumferential working surface of the cylinder when they are closed. They are alternately opened by the incoming steam pressing behind them, whenever the peculiarly-shaped piston has passed them; and owing to your *effective mode of cushioning the steam between them and the rotating valves*, they are closed gently by the piston during the time of exhaust. The front edges of the valve doors form a continuous steam-tight joint with the rotating piston, in such a manner, that the reaction due to the steam pressure between their back faces and the effective area of the piston, causes the latter to revolve. The higher the piston speed the greater is the economy of steam. The steam, after being cut off by the rotating valves, expands, doing work until it exhausts through the axle bosses of the oscillating valve doors.

PRELIMINARY INSPECTION AND VERIFICATION OF APPARATUS.

I carefully measured the volume of the boiler water supply tank, and found it to be 305 lbs. for every barrel full; checked the brake spring balances by *Government stamped standard* weights; saw that the brake ropes were properly adjusted; and found the *radius* of the brake load (r) to be 2·0417 feet, which gave the logarithm of the constant, &c., for B.H.P. $\left(\log. \frac{2\pi r}{33{,}000}\right) = \bar{4}\cdot5895$.

Log of constant	$= \bar{4}\cdot5895$
Log of mean brake pull, 93·2 lbs.	$= 1\cdot9694$
Log of mean speed, 574·5	$= 2\cdot7593$
Log of mean B.H.P., 20·8	$= 1\cdot3182$

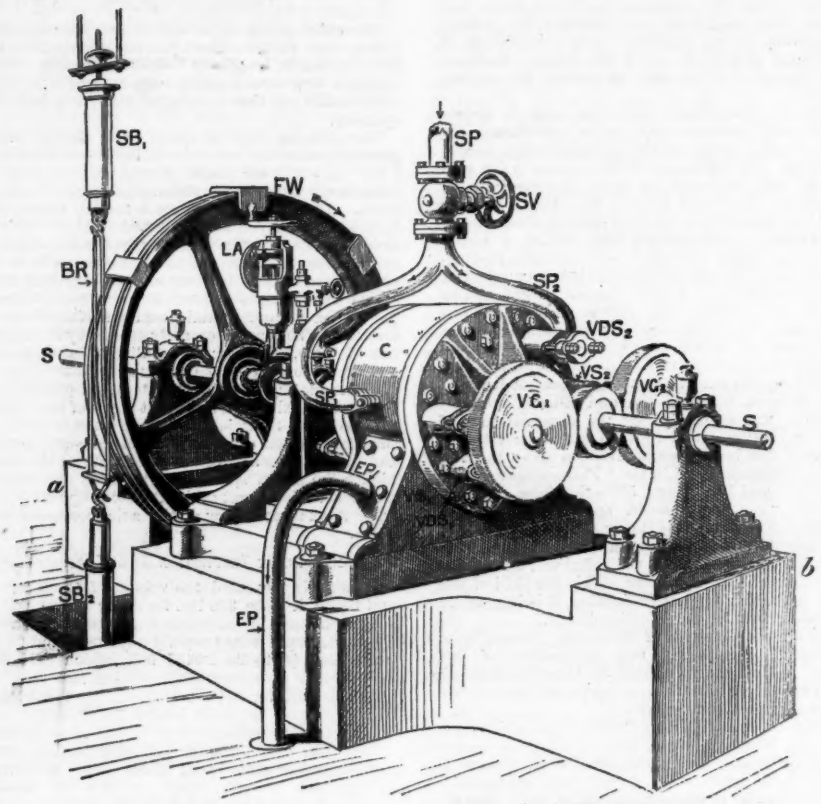
TRIAL RUN, PERIODICAL OBSERVATIONS.

With steam shut off from the engine, the feedwater was forced into your *locomotive multitubular boiler by the injector, until it reached a definite mark* (about half glass) on the polished brass scale, fixed immediately behind the gauge glass. The water supply tank was then filled up to an overflow hole, and the steam pressure raised to 93 lbs. by steam gauge. The engine was started at 2.15 p.m., at a speed of 560 revolutions per minute, and then simultaneous observations were taken every 15 minutes of the boiler pressure, net brake load, and the revolutions per minute by Messrs. Schäffer and Budenberg's tachometer (the accuracy of this instrument I had previously ascertained), from which the brake horse-powers have been calculated. The whole of my observations have been inserted in the accompanying table exactly as they were written down at the time, and the means taken from a *continuous run* extending over *five hours' duration*.

From this table it will be seen how very steadily the engine maintained its speed, and how the power developed by it gradually rose from a minimum of 18·6 B.H.P. to a maximum of 22·39 B.H.P., as the working parts warmed up. Had I been certain that the brake wheel (which was 4 feet in diameter with light arms) could have withstood a higher speed than 600 revolutions per minute, there would have been no difficulty so far as the engine itself was concerned in increasing the speed to 800 or even 1,000 revolutions per minute; as both the material and workmanship seem to be of excellent quality, and the only oscillating parts are the valve doors, which are duly cushioned during their back strokes, and always kept bearing upon the rotating piston by steam acting from behind them. Had this higher speed been attempted, there can be no doubt that the consumption of steam per B.H.P. hour would have been still less than it was, viz., *a mean* of 37·9 lbs. per B.H.P. hour. A considerable condensation of steam no doubt took place in the steam pipe, and in the too long indicator pipes, which were not lagged. The fall of pressure between the boiler and the cylinder, as shown by a comparison of the pressure gauge, and the indicator cards, amounting to fully 15 lbs. on the square inch, is due to the steam pipe being small, right angle bends, and the non-effective water trap. From the indicator cards taken by me prior to commencing the brake horse-power trial of five hours, as well as from those taken by me subsequently on June 4th, *the gross consumption of steam is only* 27·2 lbs. per I.H.P. hour; results which surpass not only any other rotary engine, *but equal those of the very best simple expansion, fast speed, non-condensing engines* (of the same power, run at the same speed and with the same steam pressure), with which I am acquainted or have seen recorded.

The indicator diagrams were taken with M'Innes's fast speed indicator, and they are remarkably good. They show an almost equally effective power developed by the steam admitted through

each rotating valve and cylinder door. The steam efficiency is only 70 per cent. of what it would have been had you been supplied with perfectly dry steam, for it appears from the indicator cards that *only* 19 *lbs. of dry steam of* 95 *lbs. absolute pressure was recorded by them per I.H.P.-hour* to the point of cut off, instead of an actual weight of feed water equal to 27·2 lbs. per I.H.P.-hour. Or, 30 *per cent. of the feedwater passed into the cylinder as water* with the steam. The mechanical efficiency of the engine and combined heavy brake wheel and gear, or ratio of brake horse-power to indicated horse-power was 71·6 per cent., but as you will only require a small fly wheel and two



BROWN'S ROTARY EXPANSIVE ENGINE WITH BRAKE GEAR, AS TESTED BY PROFESSOR JAMIESON.

Index to parts.

S P_1,	represents	Steam pipe from the locomotive boiler.	E P_1,	represents	Exhaust pipe.
S V_1,	,,	Stop-valve.	L A_1,	,,	Lubricating apparatus.
S P_1, S P_2,	,,	Steam pipes branching to each rotating steam admission valve.	S, S,	,,	Shaft to which piston, &c., are keyed.
C,	,,	Cylinder.	F W,	,,	Fly-wheel, 4 ft. diameter, specially fitted for taking the B.H.P. of the engine.
V G_1, V G_2,	,,	Valve gearing for working the steam admission valve.	B R,	,,	Brake ropes.
V S_1, V S_2,	,,	Valve spindles to which V G_1, V G_2 are keyed.	S B_1, S B_2,	,,	Salter's (spring) balances
V D S_1, V D S_2,	,,	(Oscillating) valve door spindles.			

BRAKE HORSE-POWER TESTS OF BROWN'S ROTARY ENGINE.

No. of Reading.	Times P.M.	Boiler pressure by guage. lbs.	Net brake load. lbs.	Revols. per minute.	B.H.P.	Remarks.
1	2.30	93	90	560	19·58	Each barrel full of feedwater = 305 lbs.
2	2.45	90	84	570	18·61	2.50 p.m., 1st barrel into boilcr.
3	3.0	93	87	580	19·61	
4	3.15	93	88	580	19·84	
5	3.30	93	92	580	20·73	3.25 p.m., 2nd barrel into boiler.
6	3.45	93	92	560	20·02	3.45 p.m., 3rd ,, ,,
7	4.0	93	92	550	19·66	
8	4.15	93	90	570	19·04	4.10 p.m., 4th ,, ,,
9	4.30	93	92	570	20·38	
10	4.45	98	97	570	21·49	4.35 p.m., 5th ,, ,,
11	5.0	93	93	570	20·60	
12	5.15	96	96	580	21·64	5.5 p.m., 6th ,, ,,
13	5.30	96	96	580	21·64	Engine very steady. Brake working splendidly.
14	5.45	98	98	580	22·09	5.25 p.m., 7th barrel into boiler.
15	6.0	100	96	600	22·39	5.45 p.m., 8th ,, ,,
16	6.15	97	99	560	21·54	6.10 p.m., 9th ,, ,,
17	6.30	93	94	570	20·82	6.30 p.m., 10th ,, ,,
18	6.45	93	93	600	21·69	
19	7.0	99	102	570	22·08	6.55 p.m., 11th ,, ,,
20	7.15	98	93	590	21·32	7.20 p.m., 12th ,, ,,
...	...	...	...	...	...	7·40 p.m., 13th ,, ,, less 16½ lbs.
	Means =	95	93·2	574·5	20·784	Total feedwater used in 5 hours = 3,948·5 lbs. Gross feedwater per hour = 789·7 ,, ,, ,, per B.H.P. hour = 37·9 ,, ,, ,, per I.H.P. hour = 27·2 ,,

Taken May 27th, 1891. (Signed) ANDREW JAMIESON.

bearings less in the engine you make for actual work, the mechanical efficiency will no doubt then be quite equal to 80 per cent.

After steam *was shut off* from the engine at 7.15 p.m., feedwater was injected into the boiler until it reached the *same mark* on the gauge glass scale with which we started the trial run, and the feed-water barrel was filled up to the overflow hole. From these data, I found that the engine had used a total of 3,948·5 lbs. of water during the 5 hours, or 789·7 lbs. of water per hour, which is equivalent to 37·9 lbs. per B.H.P.-hour and 27·2 per I.H.P.-hour.

These results corroborate the 5 hours' continuous tests taken by you on May 19th last. I can account for your getting the slightly better result of 37·27 lbs. feedwater per B.H.P.-hour from the steam pipes leading to the indicator being left on and unjacketed throughout my trial; whereby not only a certain amount of heat energy was dissipated by radiation, but also a percentage of steam was wasted due to this additional clearance. In fact, the initial clearance appears to have been doubled by keeping these long indicator pipes on during my brake horse-power trial.

Condition of Engine after the Brake Horse-Power Trial.

I had the right hand cylinder cover removed after the five hours' run, and found all the working surfaces in perfect order. Not only were the original tool marks everywhere visible, but a fine hard glossy skin was coming up on all the wearing parts. Both the workmanship and material are excellent, and bear out the good name attained by the makers, Messrs. John Lang & Sons, for accuracy and finish. I was particularly taken with the various self-adjusting packing strips between the sides and end of the piston and the cylinder, whereby you had so adjusted the compressive reaction of the back springs that the wear should take place evenly. The arrangements for renewing them (should occasion require the same to be done at any time) are exceedingly convenient and simple.

Improved Engine.

The present engine, although the fourth or fifth which you have made according to your patent, will, I understand, be still further improved upon in the one now being manufactured, by having a live steam jacket completely surrounding the cylinder and thus dispensing with the branch steam pipes S P_1, S P_2, as shown on the accompanying figure. It will consequently be more compact, and by having the valve gearing covered in, and the small fly-wheel overhung on the further side, the whole engine will be placed on one firm cast-iron sole plate.

Space occupied by Engine.

The space occupied by your engine is less than that of any reciprocating steam engine of the same power with which I am acquainted.

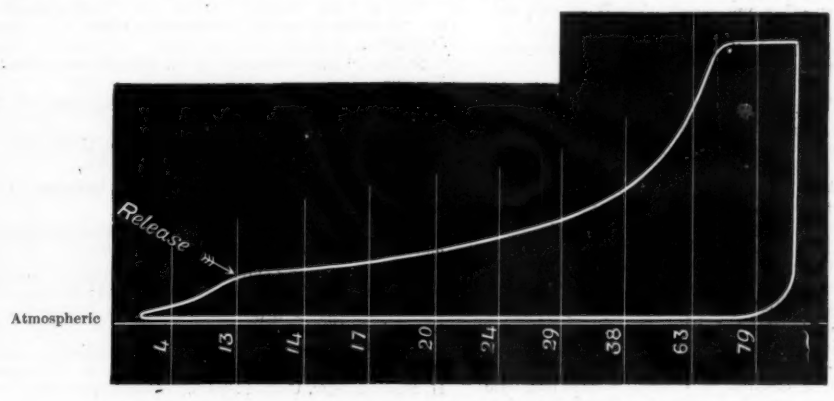
Cases in which the Engine may be Applied.

Your engine will be found most useful in working electric lighting and transmission of power dynamo machines, where a high speed, space, and uniformity of action are important qualifications. Also for driving yachts, steam launches, centrifugal pumps, fans, and gas exhausters, &c.

Indicator Cards.

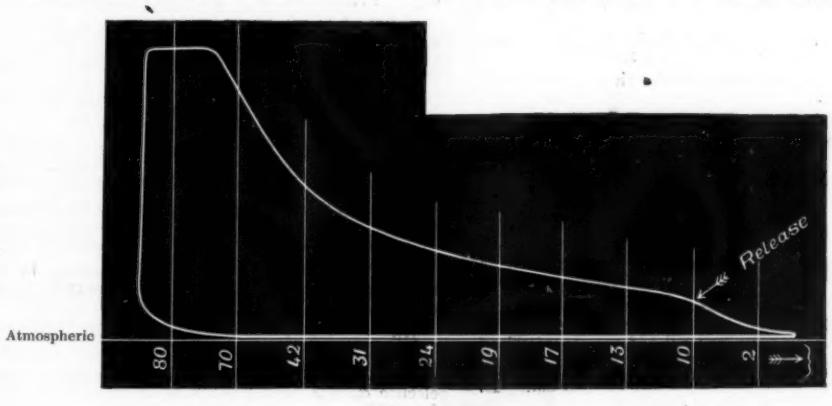
The following two cards, selected out of a large number taken by me from the right and the left hand sides of your engine, with diffe-

Right Hand.—Diagram No. 8. Boiler pressure = 95 lbs. by gauge. Scale spring 1" = 48 lbs. Taken 4.45 p.m., 4/6/91.—A. J.



Indicator card taken at 200 revolutions per minute from the right hand side of Brown's rotary engine.

Left Hand.—Diagram No. 8. Boiler pressure = 95 lbs. by gauge. Scale spring 1" = 48 lbs. Taken 4.46 p.m., 4/6/91.—A. J.



Indicator card taken at 200 revolutions per minute from the left hand side of Brown's rotary engine.

Calculation for indicated horse-power and feedwater per indicated horse-power-hour.

$$\text{I.H.P.} = \frac{\text{Plan}}{33{,}000} = \frac{30{\cdot}8 \times 1{\cdot}86 \times 29{\cdot}11 \times 574{\cdot}5}{33{,}000} = 29{\cdot}02.$$

Gross feedwater used per hour = 789·7 lbs.

Gross feedwater per I.H.P.-hour $= \frac{789{\cdot}7}{29{\cdot}02} = 27{\cdot}2$ lbs.

rent strengths of springs, on June the 4th, speak for themselves. They are reproduced full size, and the necessary data has been printed on and beneath them. The mean pressures found by ordinates in the usual way, were checked by Amsler's planimeter, which gave a slightly higher mean pressure of 30·8 lbs. per square inch for the two cards. The effective area of piston was taken as 29·11 square inches, the effective stroke as 1·86 feet, and the revolutions as 574·5 per minute, being the mean revolutions per minute observed during the five hours' brake horse-power trial, which numbers were used in calculating the indicated horse-power. The cards were, however, taken at only 200 revolutions per minute, as it was found impossible to get an even admission line at higher speeds owing to the excessive vibration of the too long indicator pipes and the reaction of the indicator spring.

(Signed) ANDREW JAMIESON.

NEW PATENTS—1891.

9,155. "Means for preventing the interference of induction currents of the earth and line wires in telephonic and other electric circuits." R. H. COURTENAY. Dated June 1st.

9,190. "An improved electric clock." S. J. DAVIES. Dated June 1st.

9,227. "Improvements in telephones." SIEMENS BROTHERS AND CO., LTD. (Communicated by Siemens and Halske, Germany). Dated June 1st.

9,241. "Improvements in or appertaining to electric railways." W. P. THOMPSON. (Communicated by C. K. Harding, United States.) Dated June 1st. (*Complete.*)

9,245. "Improvements in telegraphic apparatus." A. LINHART and C. SEITZ. Dated June 1st.

9,249. "Improvements in electromagnets for holding tools, lamps, brackets, or other articles, and for telegraphic and other apparatus." F. J. ROWAN and W. MCWHIRTER. Dated June 1st.

9,291. "Improvements in electric arc lamps." A. E. BISHOP. Dated June 2nd.

9,299. "Improvements in apparatus for electrically controlling and registering the movements of keys in connection with railway block instruments, and for other purposes." W. R. SYKES, sen. Dated June 2nd.

9,403. "Improvements in electrically insulating appliances, known as 'Suspensions.'" J. RAEBURN. Dated June 3rd.

9,418. "Improvements in movable submarine batteries." R. MACDONALD. Dated June 3rd. (*Complete.*)

9,423. "An improved holder for electric incandescent lamps." H. H. GREENFELL. Dated June 3rd.

9,435. "An electrical transformer." E. F. H. H. LAUCKERT. Dated June 3rd. (*Complete.*)

9,436. "An electrical transformer." A. D. WILLIAMSON. Dated June 3rd. (*Complete.*)

9,437. "Improvements in compasses with electrical appliances for signalling and recording the course and speed of a ship, also partly applicable to other purposes." J. VON PEICHL. Dated June 3rd.

9,462. "An electro-static switch and phase indicator." A. U. ALCOCK. Dated June 4th. (*Complete.*)

9,507. "An improved electric stop motion for engines." C. A. DAYTON. Dated June 4th.

9,522. "Improvements in alternating current electro-magnetic motors." W. STANLEY, jun., and J. F. KELLY. Dated June 4th. (*Complete.*)

9,524. "Improvements in methods of and apparatus for preventing the interference with speech on telephone circuits by induced and other currents." W. STANLEY, jun., and J. F. KELLY. Dated June 4th. (*Complete.*)

9,555. "Improvements in carbons or electrodes for arc or other electric lamps." J. E. A. GWYNNE. Dated June 5th.

9,593. "Advertising and illuminating by electric current." J. T. NEWELL. Dated June 6th.

9,606. "Improvements in apparatus for holding telephone receivers, and for placing in or out of circuit either the call or the transmitting apparatus." W. P. THOMPSON. (Communicated by S. Stein, jun., Germany). Dated June 6th.

9,627. "Improvements in thermo-electric batteries." C. D. ABEL. (Communicated by R. J. Gülcher and the firm of J. Pintsch, Germany.) Dated June 6th. (*Complete.*)

9,628. "Improvements in or connected with negative elements (positive electrodes in charging secondary cells), of voltaic batteries." D. G. FITZGERALD. Dated June 6th.

9,629. "Improvements in or relating to the negative elements (positive electrodes in charging secondary cells) of voltaic batteries." D. G. FITZGERALD. Dated June 6th.

9,637. "An improved automatic electric control or cut-out." H. ALABASTER and T. E. GATEHOUSE. Dated June 6th.

9,639. "The better insulation of electrical conductors, and to obtain immunity from fire from the use of such conductors." W. C. LOVELACE. Dated June 6th.

9,642. "Improvements in and relating to electric lamps or lighting apparatus." H. WATT. Dated June 6th.

9,683. "Improvements in electric primary batteries." T. J. D. RAWLINS and A. WALKER. Dated June 8th.

9,689. "Apparatus for supplying depolarising or other liquids to a series of electric batteries." V. JEANTY. Dated June 8th.

9,734. "Improvements in dynamic electric machines." W. ALDRED. Dated June 9th.

9,762. "Improvements in secondary or storage batteries." S. C. C. CURRIE. Dated June 9th. (*Complete.*)

9,779. "Application of vibrating tongues to produce automatic resistances in telegraph lines." M. F. F. BELLIER. Dated June 9th.

9,780. "An electric regulator." P. V. MCMAHON. Dated June 9th.

9,791. "Improvements relating to carbon electrodes for electrolytic and other purposes." J. GREENWOOD. Dated June 9th.

9,803. "An improvement in galvanic batteries." W. J. ENGLEDUE. Dated June 9th.

9,868. "Improvements in or connected with electrical signalling to and from trains." J ORME. Dated June 10th.

9,876. "Improvements in telegraph block systems of railway traffic control." D. C. COOMBES and W. ROWE. Dated June 10th. (*Complete.*)

9,887. "Improvements in and relating to microphonic or telephonic transmitters." A. T. COLLIER. Dated June 11th.

9,915. "Improvements in electric measuring instruments, electric safety fuses, manufacture of incandescent lamps, telephone transformers, electric organs, transformer distribution, envelopes." J. SWINBURNE and H. S. HOLT. Dated June 11th.

9,928. "Improvements in galvanic batteries." G. A. SCHOTH. Dated June 11th. (*Complete.*)

9,955. "An improved electricity meter." S. H. HOLDEN. Dated June 12th.

9,956. "An improved electricity meter." R. H. HOUSMAN. Dated June 12th.

9,997. "Improvements in pipes or tubes for conveying liquids and gases and for protecting and insulating electric conductors, and for other like purposes." J. ARMSTRONG. Dated June 12th.

10,016. "A new or improved dynamo-electric motor or generator." A. G. MELHUISH. Dated June 12th.

10,023. "Improvements in or relating to telegraph relays." W. P. THOMPSON. (Communicated by R. O. Wickes, United States.) Dated June 12th.

10,030. "An improved device for obviating sounds produced by the vibration of electric conducting wires." C. RIEGER. Dated June 12th.

10,069. "Improvements in or relating to electric bells." A. HOSTER. Dated June 13th.

10,082. "An improvement in voltaic batteries." P. JABLOCHKOFF. Dated June 13th.

10,090. "An improved process for the electrolytic production of aluminium." L. GRABAU. Dated June 13th.

10,121. "Improvements in arc lamp hangers." C. A. PFLUGER. Dated June 15th.

10,127. "An electric device for indicating tabulated public information." H. L. MANTON. Dated June 15th.

10,174. "A new and improved method of steering ships, torpedoes, or other floating or moving objects; an improved mechanical or electrical steering gear in connection therewith." F. S. PETT. Dated June 16th.

10,220. "Improvements in brush holders for commutators for dynamo-electric machines." R. W. BARKER. (Communicated by I. H. Bartholomew, United States.) Dated June 16th.

10,239. "Improvements in electrical block systems for railways." A. H. R. GUILEY. Dated June 16th. (*Complete.*)

10,257. "Improvements in apparatus for signalling by electricity." F. KING and W. P. MENDHAM. Dated June 17th.

10,260. "Improvements in and connected with electric signalling and lighting in trains, said improvements being also applicable for telegraphic and telephonic communication." A. SHIELS and W. ELLIOT. Dated June 17th.

10,261. "Improvements in reciprocating electric motors." H. PIEPER. Dated June 17th.

10,280. "Improvements in devices for protecting the ears when using telephone receivers." W. P. THOMPSON. (Communicated by R. Kolbe and K. Lischka, Germany.) Dated June 17th.

10,302. "New or improved coin-freed or automatic electro-magnetic induction apparatus." C. R. BONNE. (Communicated by Petsch, Kupka, and Popp, Austria.) Dated June 17th.

10,307. "Improvements in and relating to dynamo-electric machines and electric motors." C. COERPER. Dated June 17th. (*Complete.*)

10,311. "Improvements in electrically driven fans." H. G. WATEL. Dated June 17th.

10,332. "Apparatus to automatically make and break one or more electric circuits at any set time or times." A. DOUGLASS. Dated June 18th.

10,347. "Improved electric battery." D. FITZPATRICK. Dated June 18th.

10,357. "Improvements in apparatus for recording and reproducing articulate speech and other sounds." C. ADAMS-RANDALL. Dated June 18th.

10,364. "Improvements in electrical switches." A. B. GILL. Dated June 18th.

10,371. "Improvements in the production of light and the generation of heat and electricity." F. R. E. BRANSTON. Dated June 18th.

10,398. "Improvements in telephone transmitters." J. S. LEWIS. Dated June 18th.

10,425. "Improvements in or relating to means or apparatus for illuminating roundabouts and the like with electric light." F. W. DICKINSON. Dated June 19th.

10,434. "An electric metre." P. E. SINGER. Dated June 19th.

10,451. "An improvement in posts for carrying electric lights and such like purposes." W. HAYWOOD and C. H. DRIVER. Dated June 19th.

10,481. "Improvements in apparatus for synchronising electric telegraph instruments." G. A. CASSAGNES. Dated June 20th.

10,548. "Improved apparatus for mechanically winding electrical wires." W. SHARROW. Dated June 20th.